



Faculty of Computer Science and Information Technology

***SpecFAR: SPECTACLE FRAMES USING AUGMENTED REALITY***

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Bachelor of Computer Science with Honours (Multimedia Computing)

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**SpecFAR: SPECTACLE FRAMES USING AUGMENTED REALITY**

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**This project is submitted in partial fulfilment of the requirements for the degree of Bachelor  
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## **ABSTRACT**

This android mobile application implements the Augmented Reality (AR) technology specifically fitting spectacle frames. The Spectacle Frames using Augmented Reality (SpecFAR) mobile application is aimed at developing a fitting frame using AR including other interactive features which is useful to both user and optometrist or eyewear shop. Generally, the customer who wants to try and buy a spectacle frame need to come to the eyewear shop for fitting frames which is leading to less efficient in consuming time. Based on the problem, the proposed mobile application is one of the solutions that can be developed for spectacle frames using AR. Besides, the popularity of mobile application with AR is one of the reasons that this mobile application is suitable to be developed. Since most of the people nowadays are using smartphones, mobile applications can easily be downloaded and available on their smartphone. In this report, how the proposed application will be analyzed for solving the problem and achieving the objectives will be discussed. Based on this project, there are 30 users involved in the testing for this application. From the overall result, there is a high percentage of satisfaction with the SpecFAR application. As a result, the mobile application with the present of AR could attract and motivate the user to keep using the mobile app and get experienced AR by themselves.

## **ABSTRAK**

Aplikasi mudah alih android ini akan menggunakan teknologi Augmented Reality (AR) dan khususnya untuk percubaan bingkai kaca mata. Aplikasi mudah alih Spectacle Frames using Augmented Reality (SpecFAR) ini bertujuan untuk menghasilkan percubaan kaca mata dengan sokongan AR termasuk dengan ciri-ciri menarik dimana akan membantu pengguna dan optometris atau staf kedai kaca mata. Secara umumnya, pelanggan yang ingin mencuba dan membeli kaca mata hendaklah datang ke kedai kaca mata untuk percubaan bingkai dan membawa kepada kurang efisien dalam memakan masa. Berdasarkan masalah ini, aplikasi mudah alih yang dicadangkan adalah salah satu penyelesaian yang boleh dibangunkan dengan percubaan bingkai yang menggunakan AR. Selain itu, populariti aplikasi mudah alih dengan AR adalah salah satu sebab aplikasi mudah alih ini sesuai untuk dibangunkan. Memandangkan kebanyakan pengguna kini menggunakan telefon pintar, aplikasi mudah alih boleh dimuat turun dan boleh digunakan di telefon pintar mereka. Dalam laporan ini, aplikasi mudah alih yang dicadangkan akan dianalisis untuk menyelesaikan masalah dan mencapai objektif akan dibincangkan. Berdasarkan projek ini, terdapat 30 pengguna yang terlibat dalam percubaan aplikasi ini. Daripada hasil percubaan secara keseluruhan, terdapat peratusan yang tinggi berpuas hati terhadap aplikasi SpecFAR. Sebagai konklusi, aplikasi mudah alih dengan kewujudan AR boleh menarik dan mendorong pengguna untuk terus menggunakan aplikasi mudah alih dan mendapatkan pengalaman dengan menggunakan AR.

# **Title: SpecFAR: Spectacle Frames using Augmented Reality**

## **CHAPTER 1: INTRODUCTION**

### **1.1 Introduction**

Nowadays, wearing a spectacle not just as a visual aid, but is also widely used as a fashion accessory. With that necessary, optometrist and eyewear shop offer a wide selection of glass frames with varying design and colours. Basically, the customer who wanted to buy the spectacles frame needs to come walk-in to the shop and trying to wear the frame one by one. This may cause less efficient because spending too much time on choosing the frame.

The development of technology in the multimedia field, which is Augmented Reality (AR) technology, it can be one of the alternative solutions to make user easier to try glasses frames on.

This advanced technology can help the customer to decide on which spectacles frame design and the colour they want to buy. This application will ease they are trying and buying the spectacle where they do not need to walk-in to the store to try out the frames. They can try out the frame anywhere they want by using a smartphone and installing the application. It will assist customers in choose and decide the spectacles frame design and colours.

## **1.2 Problem Statement**

The mobile-based application will be developed based on the problems that occur in the current eyewear shop. First, the current method is inefficient. Spectacle users who need a new spectacle usually tend to walk-in to the store directly. They do not know the designs and colours do the eyewear shop offers before they going to the shop. That means, they just wasting their time if there is no design and colour they wanted.

The next problem faced by optometrist or eyewear shop is an accident can occur. Users usually try the frames one by one to decide which frame suits them better. User can cause an accident on the glasses during trying and keep changing the frames.

Besides that, users who try the frames usually pick the frames one by one and some of them do not know about glass care. That is why certain users just holding the glass part of the spectacle and will cause smudges.

Thus, to overcome this problem, the use of Augmented Reality technology has been proposed. Since most people nowadays using smartphones, the mobile application can easily be downloaded and available on their smartphone. In line with this idea, the project will ease users in choosing their frame and as well optometrist will ease their work in dealing with customers.

### **1.3 Objectives**

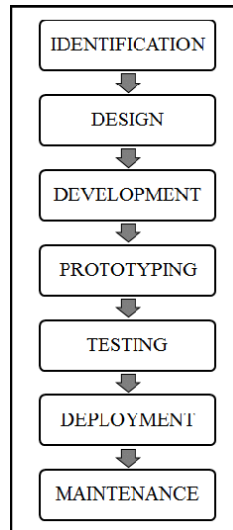
This project aims to develop an interactive spectacle frame using Augmented Reality technology to help optometrists and eyewear shops as well as to attract the user to choose their own spectacle frame from the application. Based on the problem statements and the project's aim, the objectives of this project are as follows:

- ✓ To design an interactive mobile application to attract customers to trying and choosing spectacle frames.
- ✓ To develop an efficient application for eyewear shops to serve their customers.
- ✓ To evaluate the usability of the mobile application among users.

### **1.4 Methodology:**

The methodology is the systematic, theoretical analysis of the methods applied to a field of study (Igwenagu, 2016). In order to achieve the objectives of the project, the Mobile Application Development Life Cycle (MADLC) methodology is applied to this project.

MADLC can be defined as a dedicated framework lifecycle for mobile application (Vithani, IAENG & Anand, 2014). This methodology also emphasizes process in order to provide high-quality mobile applications and minimize mobile application development problems and errors that are faced at the later stage (Kaur & Kaur, 2015).



*Figure 1. 1 Mobile Application Development Life Cycle*

Mobile Application Development Life Cycle (MADLC) will be divided into seven processes as follows:

1. Identification:

In this phase, identification is one of the most important aspects of developing a mobile application where ideas are collected and categorized. The ideas can come from the customer or the developers (Muhammad Adil & Nafees, 2015; Vithani & Kumar, 2014)

2. Design:

In the design phase, the idea from the mobile application team is developed into an initial design of the application. A very important part of this phase is to create the storyboard for the user interface interaction where the storyboard is to describes the flow of the application

### 3. Development

In this development phase, the application is coded. The coding of the application is the most important phase as it involves all the technicalities to address. The programming phase needs all the attention in order to develop applications that are bug-free.

### 4. Prototyping

In this phase, the functional requirements of each prototype are analyzed where prototype ready to test and sent to the client for feedback. Then, any required changes are implemented through the development phase. The development, prototyping and testing phases are repeated until the final prototype is ready.

### 5. Testing

The testing of the prototype types is performed on an emulator/simulator followed by testing on the real device. The testing on the real device, for example in the case of Android operating system development, should be performed on multiple operating system versions, multiple models of handsets with variable screen size. The test cases are documented and forwarded to the client for feedback.

### 6. Deployment

The deployment phase is the final phase of the development phase. After the testing is completed and the final feedback is obtained from the client, the application is ready for the deployment.

### 7. Maintenance

The maintenance is the final phase of this model and the maintenance for this application will be discontinued.



## **1.5 Scope**

The scope of this project is for

### **i. The optometrist and eyewear shop**

- ✓ Implement a new way to display frame designs and colours.
- ✓ Simplify optometrist to shows new design.

### **ii. Customer**

- ✓ Experience augmented reality (AR) in the real world.
- ✓ Simplify decision on choosing frames and colours.

### **iii. Students**

- ✓ Experience augmented reality in the real world and education.

### **iv. Content Application**

- ✓ The application is an augmented reality application.
- ✓ Interactive augmented application.
- ✓ User can interact with the application

## **1.6 Significance of Project**

The mobile-based application of SpecFAR has the potential to solve the current problems that occur by improving the current method of optometrist and eyewear shop dealing with users and provide a better facility. In the presence of this proposed mobile-based application, users do not have to come directly to the eyewear shop anymore. Users can survey, try the

frames at any time and anywhere.

### **1.7 Project Schedule**

Final Year Project takes about 8 months for the overall development. It divided into two parts which are Final Year Project 1 and Final Year Project 2. The Final Year Project 1 started from 13<sup>th</sup> September 2019 until 12<sup>th</sup> December 2019. The project schedule has been attached in Appendix A for reference.

### **1.8 Expected Outcome:**

At the end of this project, a mobile application titled SpecFAR: Spectacle Frames using Augmented Reality will be successfully developed and ready to be tested and used. Upon completion of this project, it will: -

- ✓ Support optometrist and eyewear shop to dealing with customers.
- ✓ Offer an interactive way to try spectacle frames that allows the user to experience Augmented Reality.
- ✓ Attract users from downloading the application and choose the frames anywhere they wanted.

## **CHAPTER 2: LITERATURE REVIEW**

### **2.1 Introduction**

The overall goals of this chapter were firstly to properly develop a good Augmented Reality application. Several investigations and researches are being done which is a review of several existing applications available on the market. The strength and weakness of the comparison will be discussed in this chapter to adopt the good features and applied some improvements to the proposed application.

The proposed application introduces a reliable fitting eyewear application for users and the optometrist. This application will bring along Augmented Reality (AR) technology to develop alternative solutions for users and the optometrist. To achieve the objectives of this application, a methodology needs to be done and the selected methodology is Mobile Application Development Life Cycle (MALDC). There are several phases for this methodology which are identification, design, development, prototyping, testing, deployment, and maintenance. Besides that, the project schedule has been created to ensure the progression flow of the project is in the planning period.

## **2.2 Review on Existing Applications**

This section will be reviewed and compared the four existing applications to identify similarities, differences, advantages, and disadvantages of the applications. The features of the existing applications and proposed application also will be discussed. The selected applications are: -

- i. Ideofit
- ii. Virtual Try On (VirTry)
- iii. Glassify -tryOn Glasses
- iv. GlassOn

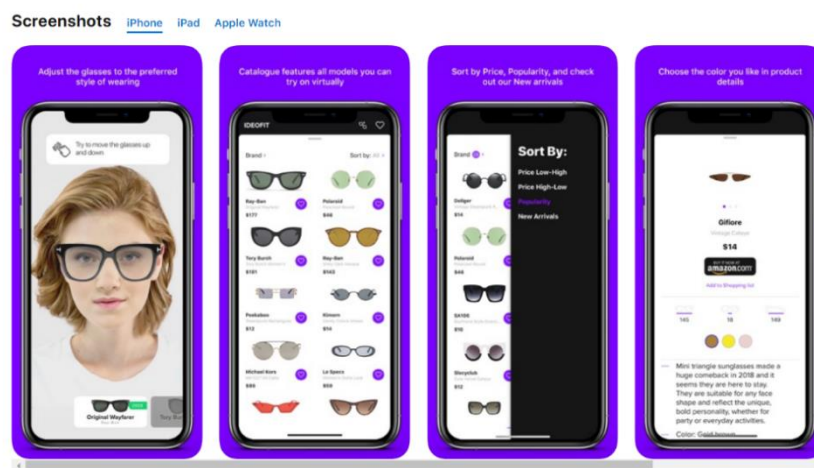
### **2.2.1 Ideofit**

Ideofit is one of application that allows users to try on eyewear using phone camera and powered by a sophisticated augmented reality (AR) technology (Krypton, 2018). Since it is only available in Apple Store, it only can be accessed by an iOS device such as iPhone, iPad and Apple Watch. Unfortunately, this application requires iOS 11.2 and watchOS 5.0 or later.

This application allowing users to discover new frame shapes and make online purchases. It will proceed to Amazon to purchase the chosen sunglasses or add them to the shopping list for the next visit. The application offered a catalogue which features all models and can sort them by the preferred filter. Users can take and share selfies while trying the virtual spectacle frames to Instagram, WhatsApp and other media social since it can save into the user's gallery. Ideofit also provides simple guide around Ideofit application. The application's guides are:

- Launch the application by tapping on the icon.

- Allow camera access.
- Start trying on selected frames.
- Adjust the glasses with a simple dragging up and down depends on user preferred style of wearing.
- Add a lens filter to spectacles.
- Take a photo and share the model with friends on social media.
- Catalogue and be visit which features all models and can sort by the preferred filter.
- Any purchase of spectacles or sunglasses will proceed to Amazon or add to Shopping List for a further visit.



*Figure 2. 1 Ideofit Application (Krypton, 2018)*

### **2.2.2 Virtual Try On (VirTry)**

VirTry is a virtual fitting application of glasses, sunglasses, headphone and earphone with 3D images without going to a physical store. VirTry allows the user to try on realistic glasses and sunglasses anytime and anywhere just in our hand. This application is developed by DMR Co., Ltd and published at Apple Store on 1<sup>st</sup> June 2017 (DMR Co., 2017). VirTry only compatible with an iOS device which is iPhone, iPad and iPod touch. Besides that, this application required iOS 9.2 or later. It also an open source for the device that compatible with and did not offer in any other market store.

For the features, the glasses move along with user face movements. The user could turn their face to the left and right, up and down to see every angle with the glasses on. User can take their image with 3D frames and videos through the application and then save them into the gallery in the user's smartphone. The user also can search the item based on tags, category and brand. This application also provides an interesting feature such as decorate them with moving sticker and coloured filters. The virtual item in this application has certain main brands. The brands are:

- Bowers & Wilkins
- Fidue
- Elecom
- Onanoff
- Meze
- Yamaha, etc

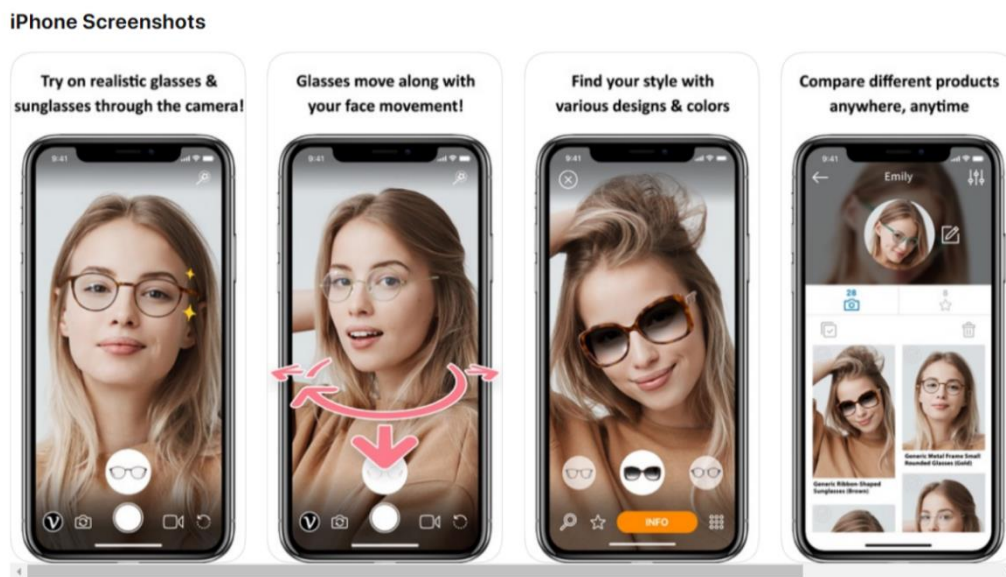


Figure 2. 2 VirTry Application (DMR Co., 2017)

This application recommends to those who;

- Want to see what kind of eyewear would look good on them
- Do not feel comfortable while trying on eyewear, headphones, and earphones in a store
- Want to compare various colour variations at the same time
- Want to be satisfied with not only the quality but also the appearance when trying on eyewear, headphones, and earphones
- Want to consider the actual fitting, not only model's images
- Want to see if eyewear, headphones, and earphones match with various clothes and hairstyles

### **2.2.3    Classify - tryOn Glasses**

Glassify is a virtual try-on eyewear and sunglasses application that let the user try a variety of frame styles under different categories, in real-time, to see which frame look great on the user. Glassify uses state-of-the-art face detection and augmented reality to virtually overlay different glasses and sunglasses on face. It is finding the perfect glass that suits user the best in no more challenges. This application is compatible for both android and iOS devices. First released of this application is on 11<sup>th</sup> November 2016 and the publisher of this application is XLabz Technologies Pvt Ltd (Ltd, 2019). It is open-source and free to both android and iOS devices.

These virtual try on eyewear offer in 2D and not in the real-time. User needs to capture a selfie of themselves and select the frames that you want to try on. Users cannot see the view from side angle and up and down angle. It only provides 2D selfie to user try on that eyewear.

There are some features from the application that has been offered. For example, a variety of different eyewear and sunglasses to try on. Besides that, there is a single view and grid view to see one glass at a time or all in one time. This application also offered different categories of eyewear and sunglasses like Aviator, Wayfarer, Ray-Ban, Dior, Vogue, Gucci, etc.



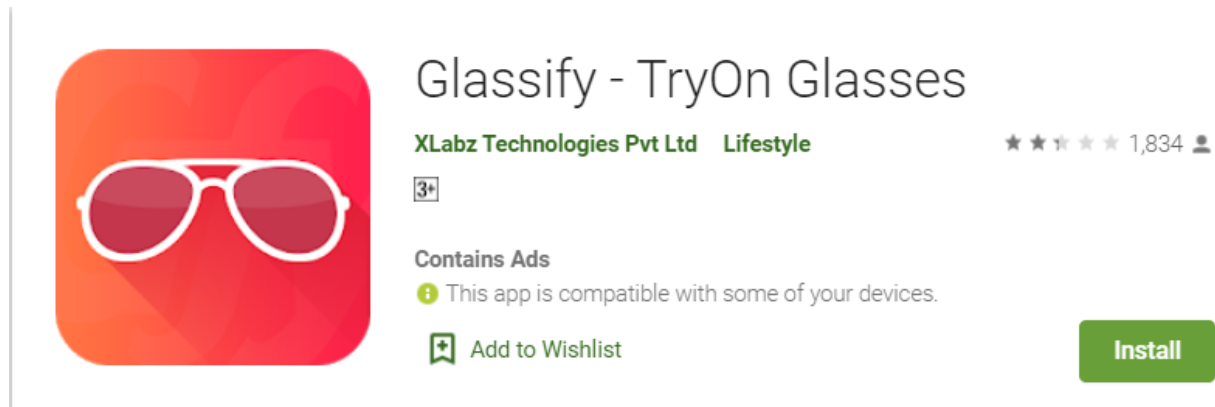


Figure 2. 3 Glassify -TryOn Glasses Application (Ltd, 2019)

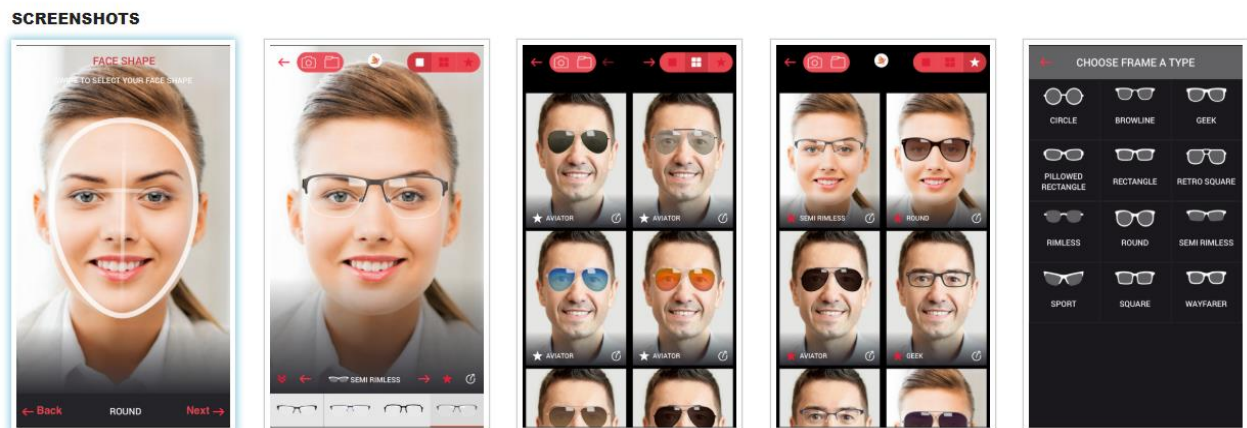


Figure 2. 4 Screenshot in Glassify application (Ltd, 2019)

Figure 2.4 shows how the user interacts with the Glassify application. The application required the user to capture a selfie and select frame they want to match with their selfie. It can display in a single view and multiple views to simplifying user's decision as shown in figure 2.4.

### 2.2.4 GlassOn Application

GlassOn is a useful application for trying on eyewear. Through Augmented Reality technology, this application brings the experience of wearing virtual glasses by real-time. User can try a lot of built-in high-quality eyewear models, or user can even customize their own eyewear and then share to anybody through social media. GlassOn also provides e-commerce website and can try that available eyewear in their website (COMPANY, 2019). GlassOn can be downloaded at Play Store and Apple Store since it is compatible with both Android and iOS devices.

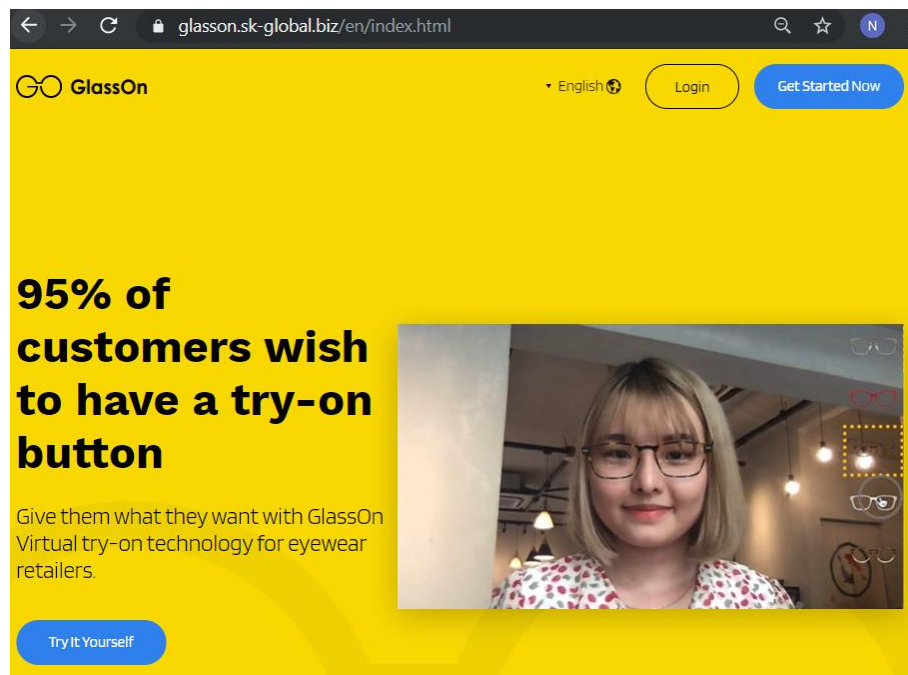
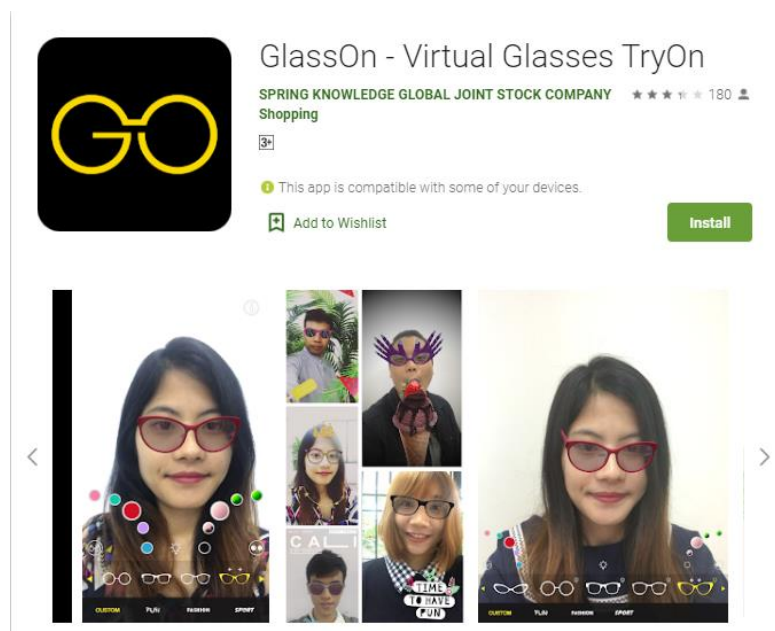


Figure 2. 5 GlassOn website (COMPANY, 2019)

In the application, they have several interesting features. One of them is the application provides a recommended eyewear that suits our face shape. Furthermore, there are a switch for

reflection effect, it is depending on the user if they want to switch on or off the reflection effect on glasses. This application also allows the user to customize the frame, colour, and design of the eyewear. The application also has its own eyewear sample which is categories into trending and funny frame. The front camera can be zoom in until 3 times so that user can zoom in their face to see the eyewear design clearly. Besides that, the most interesting feature in this application is, user can add some frame filter as shown in figure 2.6. The application also links to their store, it could easier for the user to shopping directly the eyewear they wanted.



*Figure 2. 6 GlassOn Application (COMPANY, GlassOn – Virtual Glasses TryOn, 2019)*

Figure 2.6 shows that GlassOn application is available in the Play Store and can be downloaded. In the figure also have several screenshots of review users while using the application and how they interact with the application.

## 2.2.5 Comparison of Existing Applications and the Proposed Application

The comparison between the existing spectacle frame applications has been conducted after done some exploration and using those four selected existing applications. The result of characteristics comparison is shown as in Table below.

*Table 2. 1 Characteristic Comparison between Similar Applications*

<b>Spectacle Frames Application</b>	<b>Ideofit</b>	<b>Virtual Try On (VirTry)</b>	<b>Glassify – tryOn Glasses</b>	<b>GlassOn</b>	<b>SpecFAR</b>
<b>Spectacle frames</b>	3D Object	3D Object	2D Object	3D Object	3D Object
<b>Save Image</b>	Yes	Yes	Yes	Yes	Yes
<b>Record Video</b>	No	Yes	No	No	Yes
<b>Catalogue</b>	Available	Available	Available	Available	Available
<b>Flip Camera</b>	No	Yes	Yes	No	Yes
<b>Language option</b>	English	English	English	English	English
<b>AR support</b>	Yes	Yes	No	Yes	Yes
<b>Internet connection</b>	Yes	Yes	No	No	Yes

There are strength and weakness found in each of the reviewed applications. Table 2.2 shows the comparison of the quality of the applications for each selected application.

*Table 2. 2 Comparison between Similar Applications*

<b>Spectacle Frames Application</b>	<b>Ideofit</b>	<b>Virtual Try On (VirTry)</b>	<b>Glassify – tryOn Glasses</b>	<b>GlassOn</b>	<b>SpecFAR</b>
<b>Spectacle Frames</b>	3D Object	3D Object	2D Object	3D Object	3D Object
<b>Catalogue</b>	Can be filtered	Can be filtered	Cannot be filtered	Cannot be filtered	Can be filtered
<b>Image and Video</b>	Generate only image	Generate image and video	Generate only image	Generate only image	Generate image and Video
<b>Forum</b>	Not provided	Provided	Not provided	Not provided	Provide
<b>Tutorial</b>	No	No	No	Yes	Yes
<b>Tips</b>	No	No	No	No	Yes
<b>Search button</b>	Not provided	Provided	Not provided	Not provided	Provide
<b>Compatible</b>	iOS	iOS	iOS	iOS and Android	Android



## **Brief Overview of the Proposed Application**

The proposed spectacle frames that leverage Augmented Reality technology will adapt and improve the weakness extracted based on the result found in Table 2.2.

### **2.2.6 Spectacle Frames**

Generally, SpecFAR will be implemented with 3D frames, using Augmented Reality. The spectacle frames can be viewed by the user in every angle, which left to right and up and down angle. The use of AR technology in SpecFAR, the application is a must in order to attract targeted users and optometrist. It also can access by real-time and does not need face scanning or capture their image before using the application.

### **2.2.7 Catalogue**

As we know catalogue is to simplify user to searching and finding the item based on user's need. SpecFAR will provide a catalogue that can be filtered and arrange organizable by its type. Besides that, the application will provide a search button to easier searching the model or type which user's want to try.

### **2.2.8 Forum**

The proposed application provides the users with an opportunity to contact with other user with questions, feedbacks and complaints. It can accomplish through a simple form

accessible from the mobile application. The user can read the comments that posted on the forum section. It will provide information for the other users.

### **2.2.9 Tutorial**

The proposed application will be inserted a tutorial on how to use or interact with the application. It will help the user on how to use the application and show all that can the application capable of. Other than that, the tutorial will be pop up at the screen for the first-time user that install the application.

### **2.2.10 Tips**

To makes this application differ from the existing application, SpecFAR will add some tips on how to take care of eyes and show some exercise-related to eyes that beneficial for users. Besides that, the proposed app also provides tips on suggestion frames for each type of face shape. Its help user or customer choosing their ideal frames.

## **2.3 Summary**

Chapter 2 discussed the justification of the objectives for this proposed mobile-based application. Four similar existing systems have been reviewed and summarised in a table form (refer Table 2.1 and 2.2) to compare the strength and weakness between all those applications. Although similar applications have been developed and found in the market with a wider range of feature, the consideration of getting one to be used in varsity would not be feasible. One of the reasons is the existing applications are too plain and not all the features will be utilised. Hence, developing the application of spectacle frames using Augmented Reality will be a better solution for optometrist and eyewear shop.



## **CHAPTER 3: REQUIREMENTS ANALYSIS AND DESIGN**

### **3.1 Introduction**

In the earlier chapter, four similar mobile application has been reviewed, and all of strengths and weakness has been identified including the proposed mobile application that adopting the strength during the development phase of the application.

Thus, this chapter discussed the methodology chosen in developing the proposed mobile application along with the elaboration of tasks and procedures involved. Methodology act as a guideline and frame to achieve the objectives and a successful mobile application.

The chosen methodology in the proposed mobile application is Mobile Application Development Life Cycle (MADLC). The term phases of MADLC is quite similar to the Software Development Life Cycle (SDLC) in term of phases. Besides that, MADLC is comparatively much better than using SDLC since the proposed project is focused on the development of the mobile application.

### **3.2 Mobile Application Development Life Cycle (MADLC)**

Mobile Application Development Life Cycle is used as the methodology in this proposed project. As figure 3.1, MADLC has seven phases which are identification, design, development, prototyping, testing, deployment and maintenance.

### **3.2.1 Identification**

Identification phase is the first phase before started the development of the proposed mobile-based application using MADLC methodology. The requirement and problems faced by user and optometrist or eyewear shop staff will be collected and analysed to identify the objectives of the proposed mobile-based application.

#### **3.2.1.1 Survey**

Tools for collecting data needed in natural settings. In the collecting data method for the proposed application is distributing a questionnaire to the user and eyewear shop or optometrist. For the questionnaire, the structure of the questions needs to be clarity and simplify, including visual icon, items and scales (Vaataja & Roto, 2014).

The questionnaire is divided into two, which are for user and optometrist or eyewear store staff. There are 35 respondents respond to the questionnaire. The sample of the questionnaire for both user and eyewear shop or optometrist as shown in figure 3.1.

The data collection letter is important because we need a proof showing that the data that we collected is only for final year project purpose. The data collection letter has been attached in Appendix B for reference.

The questionnaire cover is for describing what is the content of the questionnaire about and summarise it into one page which is the questionnaire cover. If respondents have any question regarding the survey, they can contact directly through the contact at the questionnaire cover. The questionnaire cover has been attached in Appendix C for reference.

The section A in the questionnaire for the user is for personal details and just a quick background regarding the spectacle matter. This section is for analysis between background and the user reaction which is in section B.

The questionnaire in section B questionnaire for the user. This section is for user reaction about augmented reality and the proposed mobile-based application. The result is being recorded so monitoring what user feel about the AR technology that will be implemented in the proposed mobile app.

A questionnaire for optometrist and eyewear shop staff attached in Appendix D for reference. The questionnaire distributed at eyewear shop around Kota Samarahan and Kuching. The questions are direct and straight forward to easier the staff answer all questions.

The total number of respondents for the user that participate in the survey about spectacle frames using Augmented Reality is about 30 people. 20 of respondents are female and 10 of respondents are male. 29 out of 30 respondents were between 18 to 35 years old. There are only 40% of respondents wearing spectacle while 86.7% of respondents have come to eyewear store and seek optometrist.

### 1. Which do you prefer to buy eye wear?

30 responses

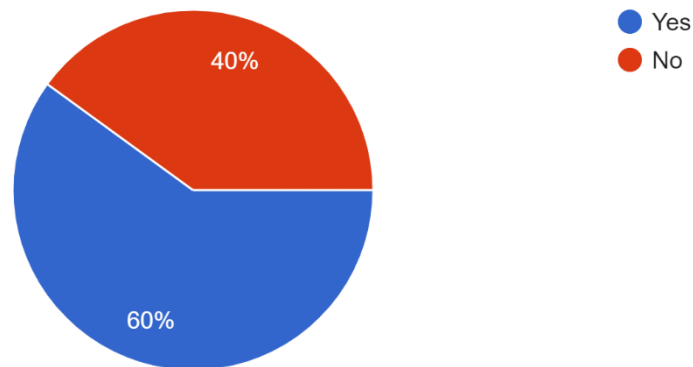


*Figure 3. 1 Result on Preferred Store*

Figure 3.8 shows the result on what user preferred to buy their eyewear. The result shows 100% which is 30 out of 30 respondents preferred to buy eyewear or spectacle in physical store which is by walk-in themselves. The proposed app can be installed in the eyewear shop and user can download and install by themselves at home or everywhere. There is no online transaction will be implemented because the spectacle lens needs to have a correct lens power and an appropriate power along the surface of the lens needs several methods to developed (Mendoza-Villegas, et al., 2014).

### 3. Have you heard about Augmented Reality?

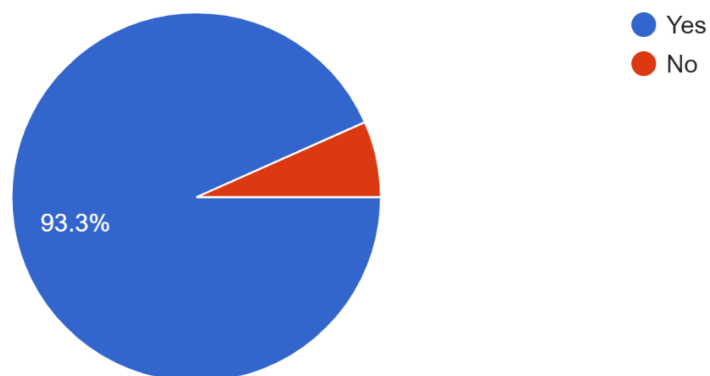
30 responses



*Figure 3. 2 Result about knowledge of Augmented Reality technology*

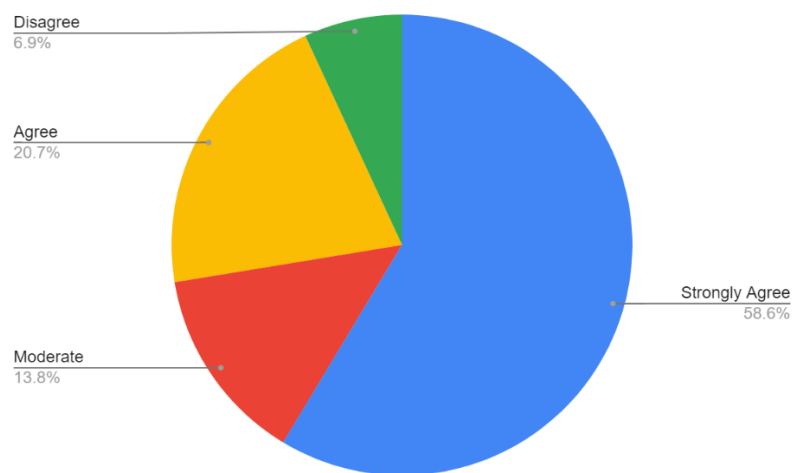
### 4. Have you experienced Augmented Reality in mobile applications? (such as Snapchat and Instagram filters)

30 responses



*Figure 3. 3 Result on experienced user on AR*

Based on the questionnaire figure 3.9 and 3.10, approximately 93.3% of the respondent has experienced the Augmented Reality in other application such as Snapchat and Instagram camera filter features. Somehow, 40% of them never heard and did not know about AR. That means they have experienced AR, but they did not know what AR is. This means it is a good idea to develop the proposed mobile-based app so that more people can experience it.



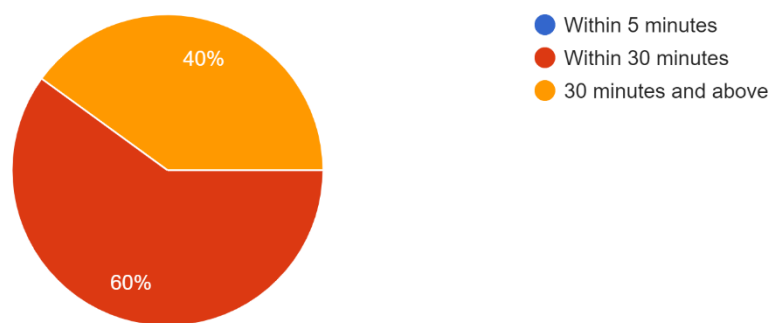
*Figure 3. 4 Result on developing AR app for fitting frames*

Figure 3.11 shows the result on what user think of the development of the proposed mobile-based app. 79.3% of respondents are strongly agreed and agree with the proposed app to develop. Unfortunately, 6.9% of the respondents which is a minor percentage has disagreed with the development of the proposed mobile app. That is because they preferred to try on the real spectacle frame on their own. The major percentage is fell into the agreed decision. That means more people want to try and experience the fitting frame by using AR.

The questionnaire for optometrist and eyewear shop staff distributes to 5 respondents. 80% of the respondent is female and the other 20% is male. All the respondents are around 18 – 35 years old. The eyewear shop is quite busy, and a lot of customers come to their store per day.

#### 4. How long the time taken for you assist your customer?

5 responses

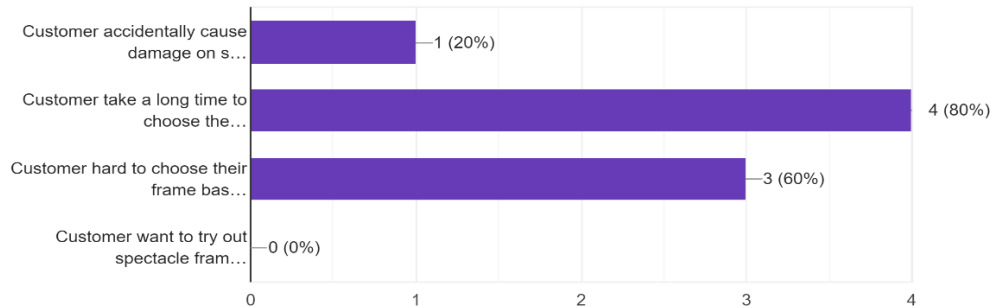


*Figure 3.12 Result on time is taken for optometrist and staff assist customer*

The result in figure 3.12, 60% of the respondent has assisted within 30 minutes per customer and 40% of them has assisted their customer about 30 minutes and above. That is mean they took a long time to assist their customer. None of them said that they assist their customer within 5 minutes. The proposed mobile application is to encounter this kind of problem. The mobile-based app with AR technology for fitting spectacle frames is a good idea and can shorten user time for deciding the frame and optometrist time to assisting them.

5. Have you faced such following problems during assisting your customer?  
If yes, choose your answer below.

5 responses



*Figure 3.13 Problems during assisting the customer*

In the result based on figure 3.13, a high percentage has answered that the customer takes a long time to choose a frame which is 80%. Meanwhile, 60% of the respondent has answered that customer hard to choose their frame based on their face shape. The other 20% said that customer have accidentally caused damage to the spectacle in their shop. The proposed mobile-based application is a really good idea to develop to solve all those problems that have been faced by optometrist or eyewear shop staff. The proposed app will help the customer decide their favourite frames and can reduce a problem which is customer will accidentally damage the spectacle frames because the customer can try out their frame in AR technology. In the proposed app, there are some tips for the user which are eye care tips and suggestion frame by face shape tips. It may help user finding their face shape type and get some info which frame types match their face shape.



### **3.2.1.2 Functional Requirement**

The functional requirements for the proposed project described what the application should offer and provide for users. The way the application behaves. in several situations also being discussed. The following are the main functional requirements to build the proposed application:

- i. The application enables the user to see themselves with the spectacle frames by using the camera in the proposed application. The proposed application is leveraging the AR technology with camera access in the application in order to view the spectacles frame on the user's face.
- ii. The application shall allow the user to view a catalogue of the spectacle frames. The application changes the spectacle frames on the user's face with a click in the application.
- iii. The application shall provide some tips such as eye care and suggested frames for types of face shape.

### **3.2.1.3 Non-Functional Requirement**

The non-functional requirement for this proposed project describes the quality attribute of the mobile application. It is essential to ensure the usability and effectiveness of the entire operation of the proposed project. The following are the non-functional requirements of this proposed mobile application:

- i. The application shall support most of the Android devices by fulfilling the minimum installation requirements. The proposed application shall support device with minimum Android Version of 5.0 and above.
- ii. The application shall offer 3D spectacle frames which AR are being implemented. The 3D objects are always having better visualization to attracts the user.

### 3.2.1.4 Software

In this development of the proposed application, the use of the software requirements is being highlighted. The requirement of the software that has been considered is an operating system, application development tools, augmented reality development tools, and graphical design tools.

*Table 3. 1 The software requirements needed to implement SpecFAR Application*

<b>Software</b>	<b>Requirement</b>	<b>Description</b>
Operating System	Windows 10	Windows 10 is used as the platform for PC to develop and design the proposed mobile-based application.
Application Development Tools	Android Studio Unity	Android Studio is the official integrated development environment (IDE) for android application development.
Augmented Reality SDK Development Tools	Vuforia	Vuforia is a developer platform for Augmented Reality design and development. It also implements recognition of different types of visual objects, text and environments recognition. This AR SDK supports both Android and IOS devices.
Graphical Design Tool	Blender Adobe Photoshop SketchUp	Blender, Adobe Photoshop and Sketchup are the tools to design the 3D object for the proposed application.

### 3.2.1.5 Hardware

The development of the proposed project needs to involve the use of hardware. The hardware has the following requirements or specifications:

*Table 3. 2 The hardware requirements to develop SpecFAR Application*

Hardware	Requirement	Description
Processor	Intel Core i7	A faster process of Central Processing Unit (CPU) can perform faster pace for compilation and deployment of software used. The processor requirement for Unity is set to a minimum of Intel Core i5.
Random Access Memory	8GB RAM	AR requires huge rendering process for the #D graphics modelling and animating. To ensure the performance of the hardware running well, a large RAM is needed, which is at least 4GB.
Graphic Processing Unit	Nvidia GeForce GTX	AR relies on marker-based tracking which involves image processing and to ensure the result to be generated in a faster way, a minimum 1GB is needed.
Hard Disk Space	30GB and above	Hard Disk Space is used to store the software needed to develop the proposed application. A minimum 30GB is needed to

		store the Unity, Blender, and other software related.
Testing Equipment	Android Device	An android device will be used for testing application development. Since the AR needs to perform using the image captured by the camera, an android smartphone with the camera will be used. The minimum requirement for testing the application is Android version 5.0 and above.

### **3.2.2 Design**

The design phase is the phase when the initial design of the proposed mobile-based application is being developed. The proposed project is specially designed for the user to try fitting spectacle frames.

### 3.2.2.1 Activity Diagram

An activity diagram is useful to depict the workflow from one activity to another activity of the proposed mobile-based application. The purpose of the activity diagram is to capture the dynamic behaviour of the mobile-based application.

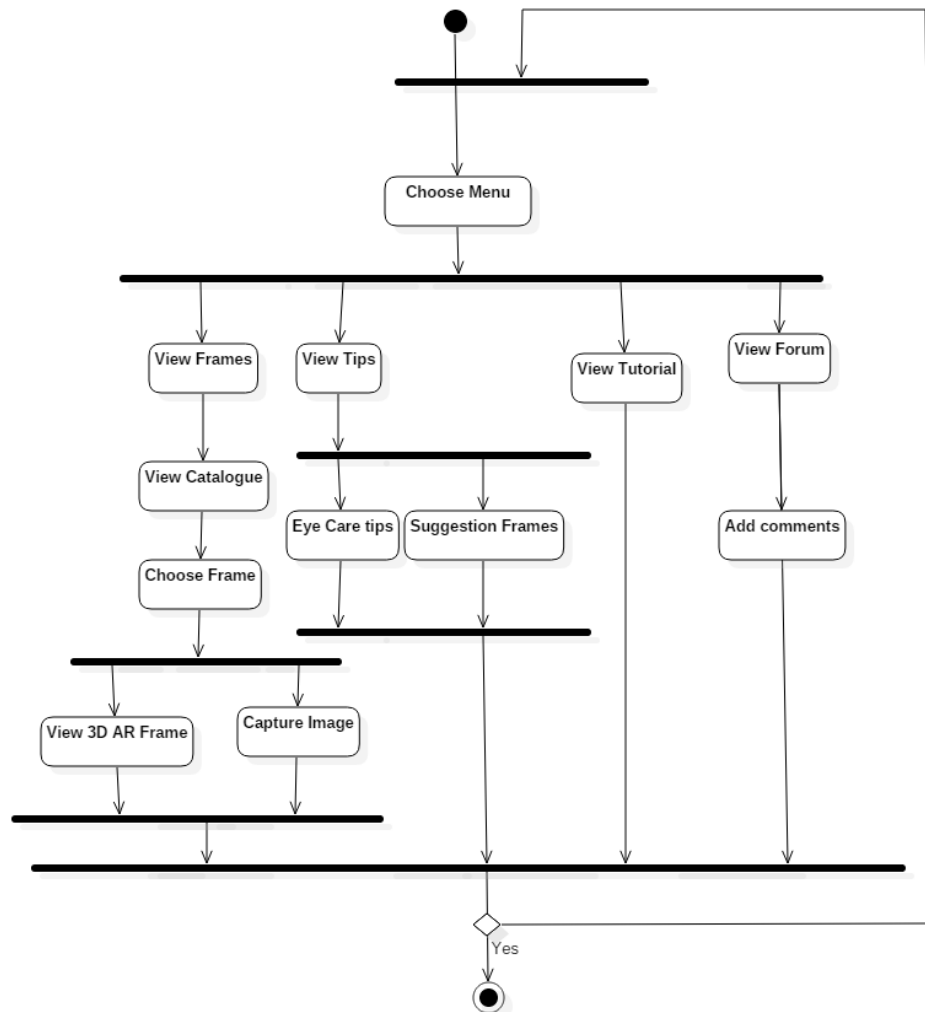


Figure 3.14 Activity diagram for SpecFAR App

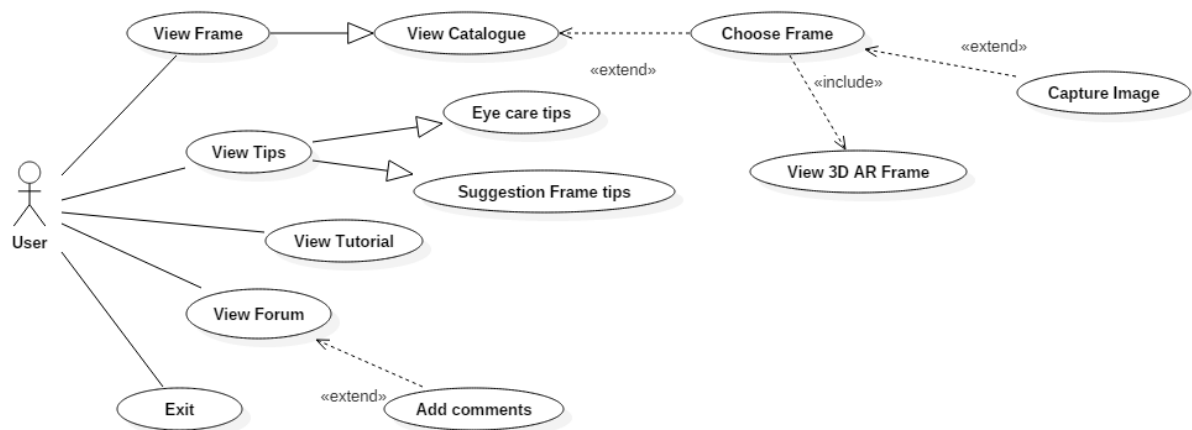
Figure 3.15 Use case diagram for userFigure 3.14 Activity diagram for SpecFAR App

Figure 3.14 represents the activity diagram of the proposed mobile-based application. The user needs to choose the menu on which action to be performed. Once the user chooses the

menu, the app will perform an action based on the chosen menu. If the user chooses the view frame menu, the app will be showing user fitting the AR frames. User can continue the processes by displaying a catalogue and trying another spectacle frame. User can decide whether want to capture the image with the AR frames or just exit the application. SpecFAR app also provides several tips for the user, such as eye care and suggestion frame based on face shape.

### 3.2.2.2 Use-Case Diagram

The use case diagram consists of the actors, uses case, and relationships that used to gather the requirements of the application that will include the internal and external influences.



*Figure 3.15 Use case diagram for user*

Figure 3.15 shows the use case diagram of SpecFAR application. The use case diagrams illustrate several interactions between the actor and the SpecFAR application, in which the

actor in this use case is the user and the optometrist or eyewear shop staff. The use case in this proposed app is including view the 3D frames in AR, view tips, view forum and view tutorial.

The use case illustrates the interaction between the user and the mobile-based application. The user has to select the menu to view frames, view tips, view tutorial, view forum and exit from the application.

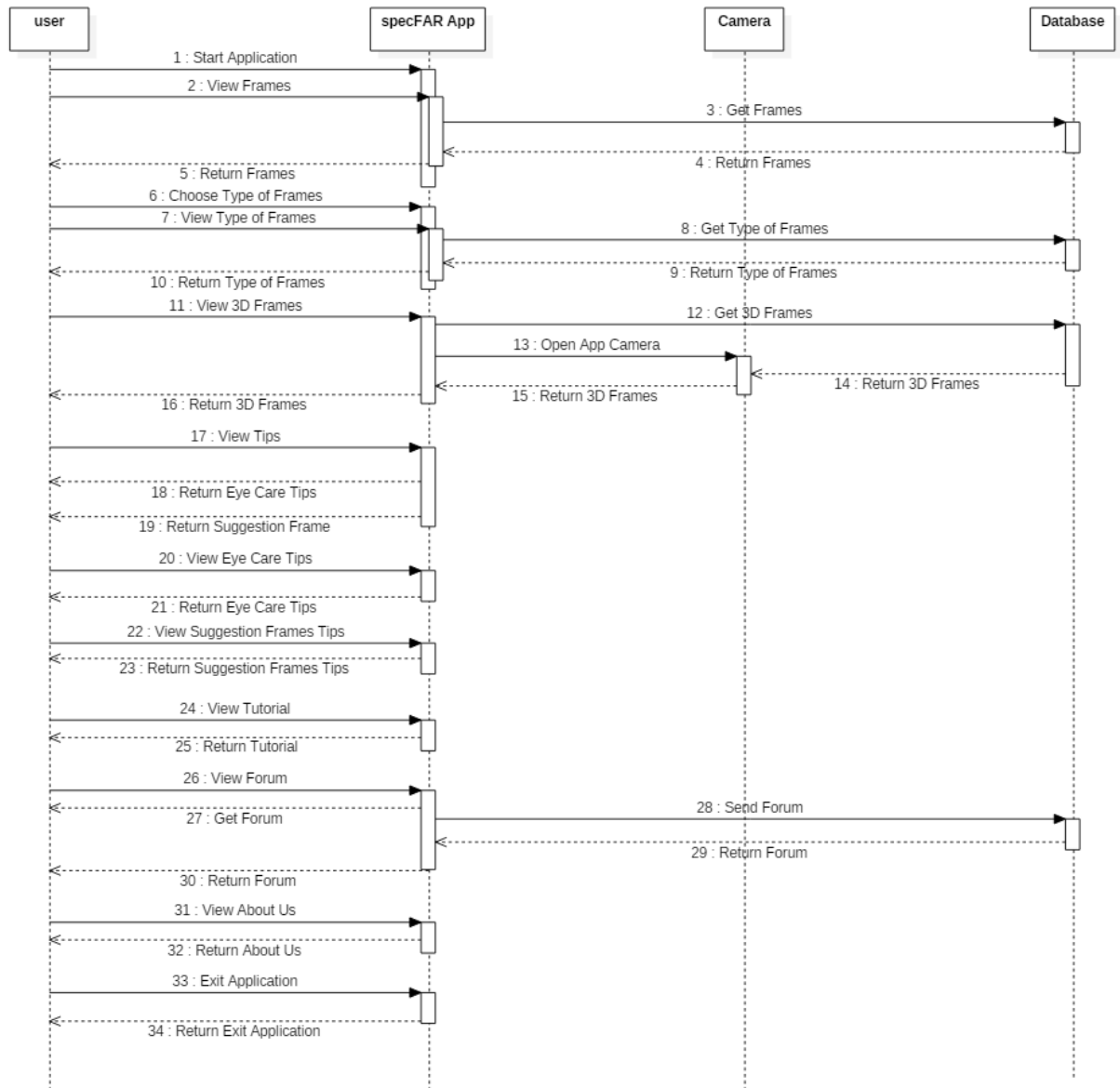
*Table 3. 3 Use case diagram description*

Use case name	User Activities
Primary Actor	Customer
Entry condition	There must be an available internet connection to perform all the activities.
Flow of events	<ol style="list-style-type: none"> <li>1) User can select the menu from the application.</li> <li>2) User can view frames and can access all types of frames in the catalogue.</li> <li>3) User is able to experience 3D AR frames and capture their image with the AR spectacle frames.</li> <li>4) User can select view tips and there are tips for eye care and suggestion frames by their face shape.</li> </ol>



	<p>5) User can view the tutorial on how to start, interact, and exit the application.</p> <p>6) User can view the forum and add comments to the forum.</p>
Exit condition	User can exit from the application.

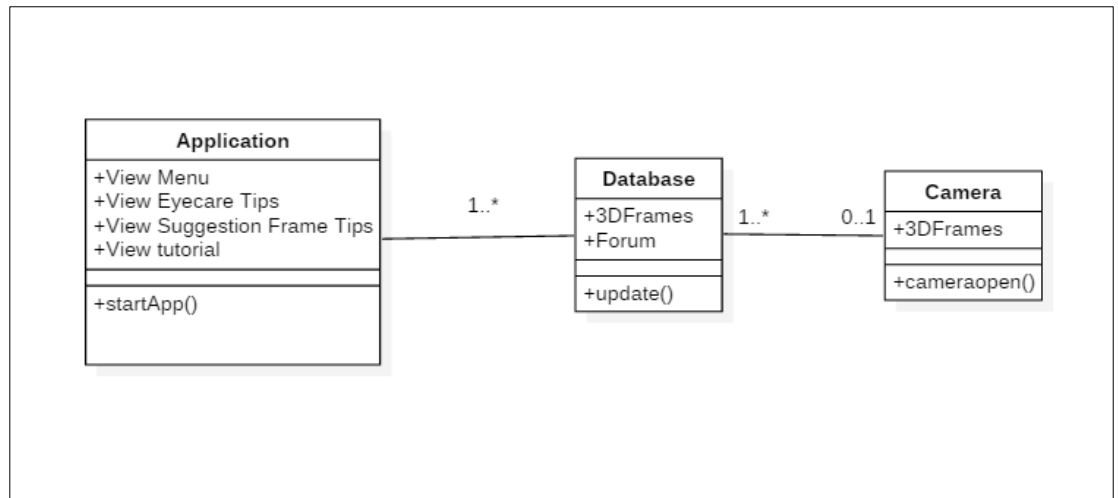
### 3.2.2.3 Sequence Diagram



*Figure 3.16 Sequence Diagram*

Figure 3.16 shows the sequence diagram of SpecFAR application. A sequence diagram is more focusing on time sequencing, time ordering messages, and the order in which messages are sent. It represents the phase of time graphically (Song, 2001). The component used in the sequence diagram is lifelines, process and message exchanges between arrows.

### 3.2.2.4 Class Diagram

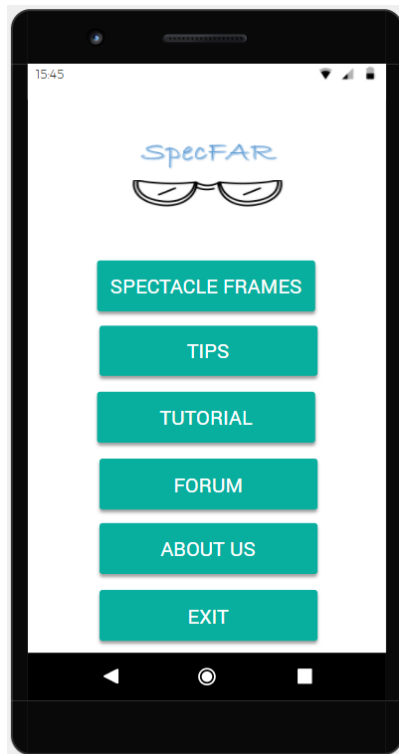


*Figure 3.17 Class Diagram*

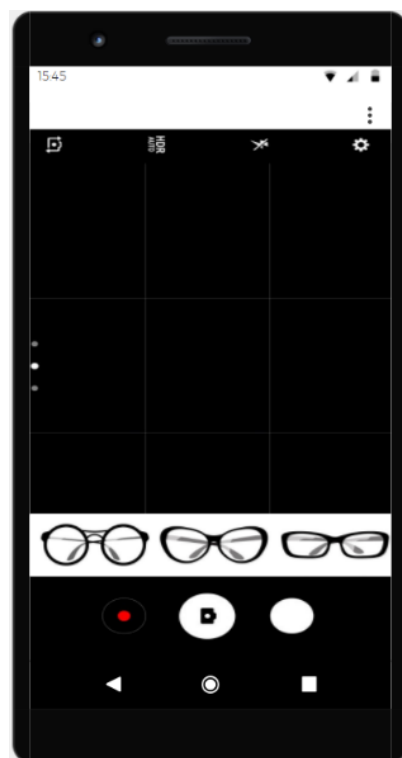
A class diagram is a static diagram that shows the static view of the application. The class diagram is used for visualising, describing, and documenting the proposed application. It also constructs an executable code of the proposed app. The class diagram shows the classes in order, attributes, operations of each class and the relationship between each class. Figure 3.17 shows a class diagram of the proposed mobile app.

### 3.2.2.5 User Interface Design

A well-designed graphical user interface (GUI) or user interface (UI) represent the structure of the mobile-based application once it is completed. The main design of the mobile-based application for Spectacle Frames using Augmented Reality is shown in the figure below.



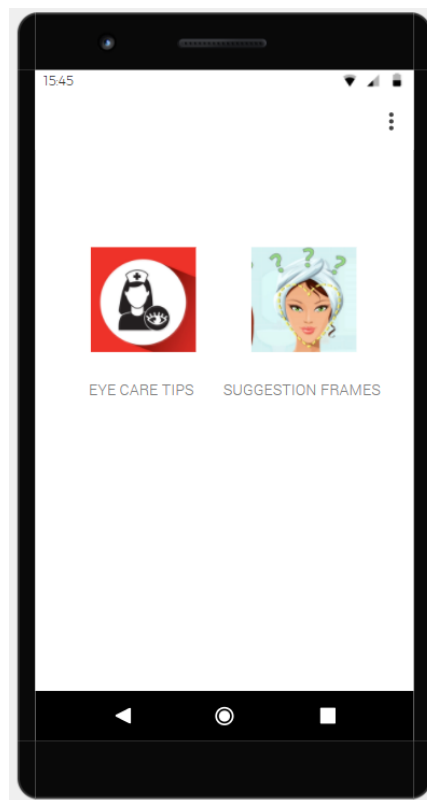
*Figure 3.18 Menu Page*



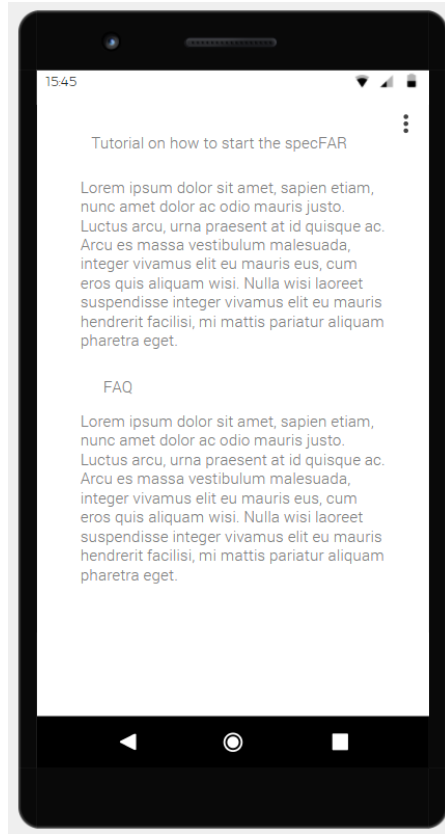
*Figure 3.19 Fitting Frames Page*

Figure 3.18 shows the sample menu page of Spectacle Frames using Augmented Reality while figure 3.19 depicts the Fitting Frames Page of the application. User needs to choose the menu button based on what action they want to perform. The menu page offers six buttons which are spectacles frames, tips, tutorial, forum, about us and exit.

For the Spectacles Frames choice, the page will display fitting frames page which is required user's face for authentication. The application will identify face shape and detect where the eye's part to perform an action where the AR frames will be displayed.

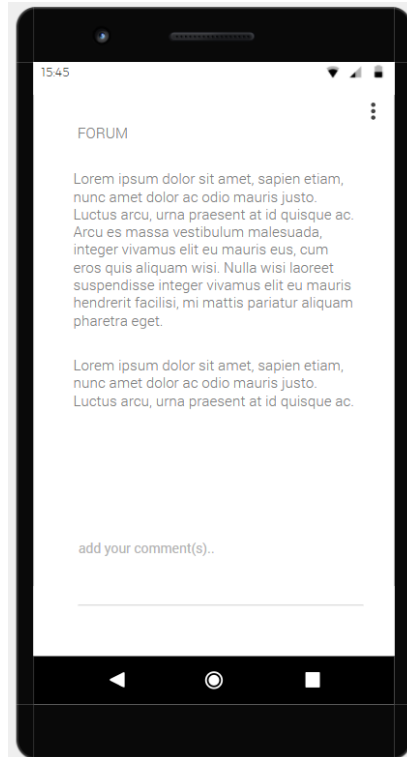


*Figure 3.20 Tips Page*



*Figure 3.21 Tutorial Page*

Figure 3.20 shows a tips page where there is two option for the user to select. The proposed app will perform an action if the user selects the menu. The menu options are eye care tips and suggestion frames tips. In the eye care tips, there is some interactive reading material on how to take care of the eyes. Meanwhile in the suggestion frames tips, the user will be guided on how to identify what shape type our face is and give some suggestion what frame types look good on the user.



*Figure 3.22 Forum Page*



*Figure 3.23 About us Page*

Figure 3.22 shows a forum page for the user. User can view comments of another user in this section. The forum page will appear once the user chooses the menu and hit the button forum. User can give comments and give any suggestions regarding the SpecFAR app. While figure 3.23 shows an about us page. The page is all about the proposed mobile-based application.



### **3.2.3 Development**

The development phase will be the most crucial stage since the proposed mobile-based application is being developed at this phase. The application is coded using Android Studio with Augmented Reality Development Tool, Vuforia. The code is developed first for the core functionalities, such as the development of fitting frames and develop the design of spectacle frames.

In the second stage, user interface (UI) is designed so that it can support on as many mobile operating system platforms (Raus, Canda, Mohd Azam, Sariman, & Wan Norman, 2016). The UI is being highlighted because it may affect user interactivity and interest of the user. Lastly, the documentation of the development phase is forwarded to the prototyping phase.

### **3.2.4 Prototyping**

In this phase, the functional requirements of the prototype will be analysed and tested to gain some feedback from the user. The feedback will be documented and if any required changes need to be through the development phase. The development, prototyping and testing will be repeated until the finalize prototype are successfully approved. Once the prototyping phase is done and being documented, the phase will continue to the testing phase.

### **3.2.5 Testing**

Testing is the most important phases in any developing life cycle. The testing of the SpecFAR prototype is performed on an android device. User can install SpecFAR into their android mobile device for the purpose of User Acceptance Testing (UAT). The testing phase will be documented and continue to the next phase.

### **3.2.6 Deployment**

Deployment is the final phase in the Mobile Application Development Life cycle. Once the testing phase is completed and the final feedback is obtained from the user, the application is ready for the deployment. The uploading process will require several guidelines outlined by Google and telecommunication service provider (Raus, Canda, Mohd Azam, Sariman, & Wan Norman, 2016). For further usage, the user can install the application on their android mobile device.

### **3.2.7 Maintenance**

The final phase of MADLC methodology is the maintenance phase. This phase is known as post-development phase since the proposed project is the continuous phase. The importance of implementing maintenance becomes unquestionable and this phase to ensure the application are customer satisfaction, product quality, system productivity, availability and safety. Unfortunately, this phase will not be implemented in this proposed project since it is only for Final Year Project and any continuous actions are not be taken.

### **3.3 Summary**

In conclusion, all the requirements of the proposed project have been analyzed in detail. A functional and non-functional requirement is being discussed thoroughly as well as hardware and software requirements. Furthermore, the Unified Modelling Language (UML) is used to describe user actions and application behaviours. The UML diagrams involved are activity diagram, use-case diagram, sequence diagram and class diagram. From the interactivity, the user interfaces for the proposed project have been initially illustrated into a low-fidelity prototype. In line with this, the low-fidelity prototype will be implemented in the next chapter to develop the high fidelity SpecFAR application in achieving the present of Augmented Reality.

## CHAPTER 4: IMPLEMENTATION

### 4.1 Introduction

This chapter focuses on the implementation of the Spectacle Frames using Augmented Reality (SPECFAR). The implementation phase will be carried out based on the requirement and analysis design gathered that mentioned in Chapter 3. The essential software that is used in building the application is Android Studio and Unity 3D, while the AR camera using Vuforia camera.

### 4.2 Development Configuration

The software used to develop SPECFAR required installation and configuration before the development started. The software required to build this project are Unity and AR Sceneform. Both tools which are Unity and AR Sceneform must be configured concurrently to set up a basic environment to implement the Augmented Reality features. The Google Sceneform Tools need to be installed in order to start up the AR camera.

#### 4.2.1 Google Sceneform Tools

The Google Sceneform Tools is a plugin and need to be installed to start up the AR camera. The plugin needs to import into the Android Studio and configure the project files.

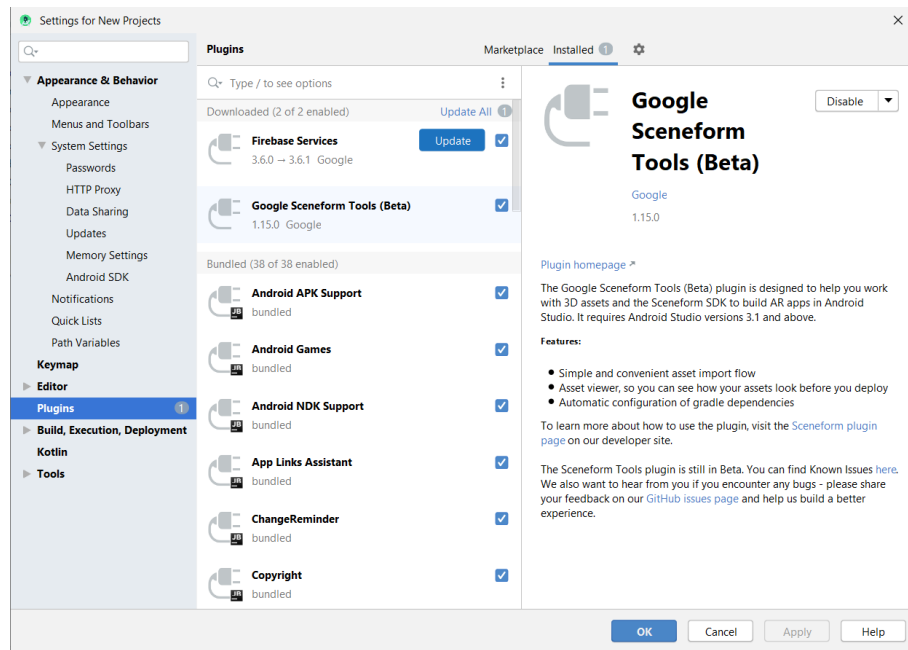


Figure 4. 1 Google Sceneform Tools

Figure 4.1 shows the installations of the Google Sceneform Tools in the project. Next, the coding and files need to be configured before starting the project.

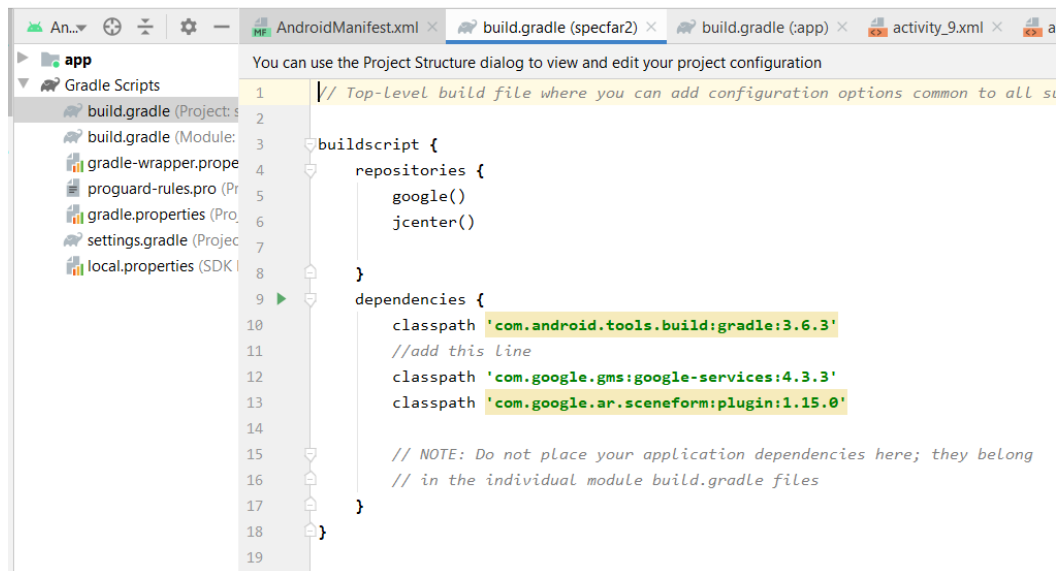


Figure 4. 2 Configuration of Google Sceneform Tools Part 1

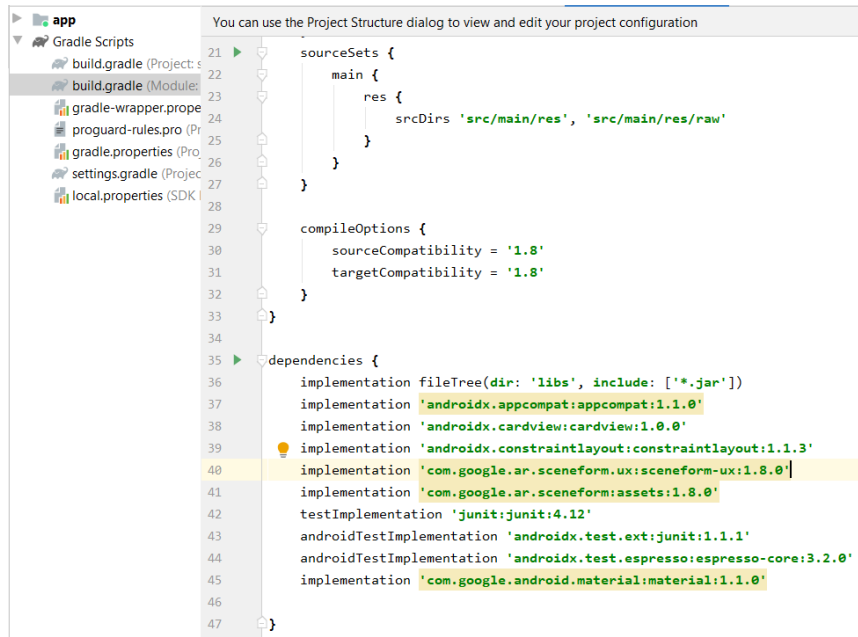
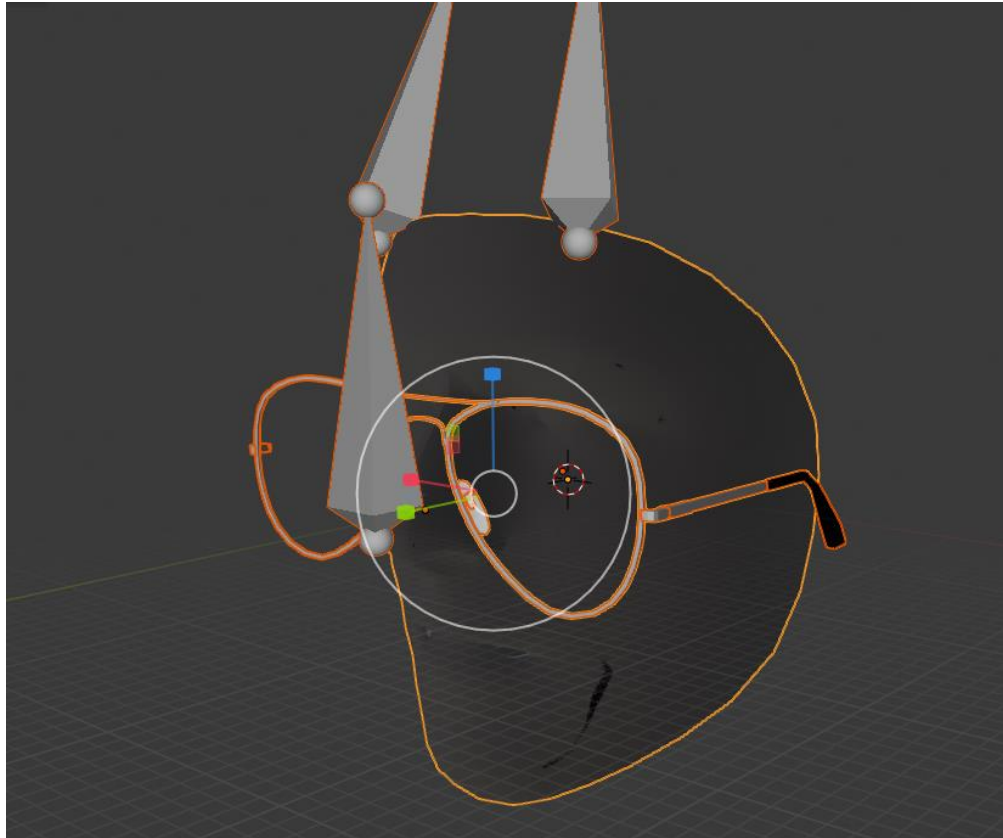


Figure 4. 3 Configuration of Google Sceneform Tools Part 2

Figure 4.2 and Figure 4.3 shows the configurations of the Google Sceneform Tools in the files of the project. This step needs to be done if the project is related to Augmented Reality.

#### 4.2.2 Unity

Unity is a multiplatform engine that allows developers to create a 3D model. It also produces 2D and 3D video games as well as non-game interactive simulations and visualisations, virtual reality, augmented reality and additional features. Since the object using the 3D model, unity used to design the spectacle frames and import to the project. Besides Unity, other tools can be used for creating 3D models such as Blender and SketchUp.



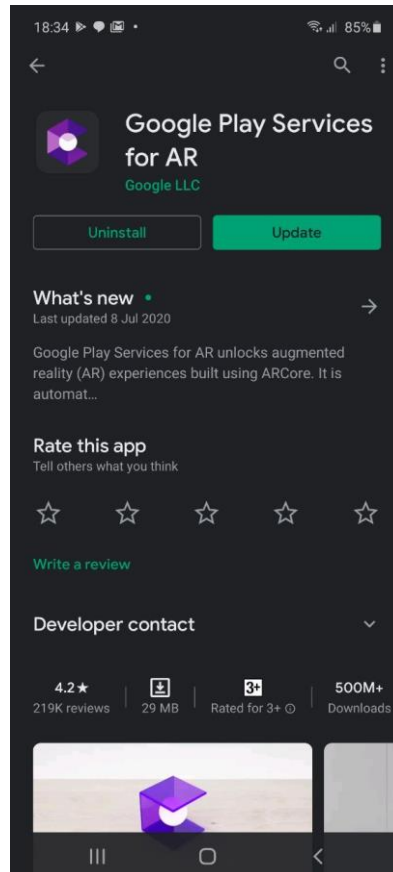
*Figure 4. 4 3D model of Spectacle Frame*

Figure 4.4 above shows the 3D spectacle frame located with the face mesh provided in the Google Sceneform Tools. The face mesh model is to ensure the spectacle frames in on the right track in the users face.

### **4.2.3 Google Play Services for AR**

Google Play Services for AR is automatically installed and updated on supported devices. This service unlocks augmented reality (AR) experiences built using ARCore. Automatic updates ensure that apps with AR functionality work without requiring an additional download. Previously, this service is known as ARCore. Apps without the service do not compatible and support AR experiences. There are the list of android devices that compatible and support AR experiences at the ARCore website. The emulator that supports the service is

required android 8.1(API 27) or later. The rear-facing camera is emulated with a virtual scene while the front-facing camera is not supported.



*Figure 4. 5 Google Play Services for AR*

Figure 4.5 shows the Google Play Services in the Play Store of Android. Both rear-facing camera and front camera need the services to access the AR camera. However, the services need to be updated or else it cannot access the AR camera.

### **4.3 Application Implementation**

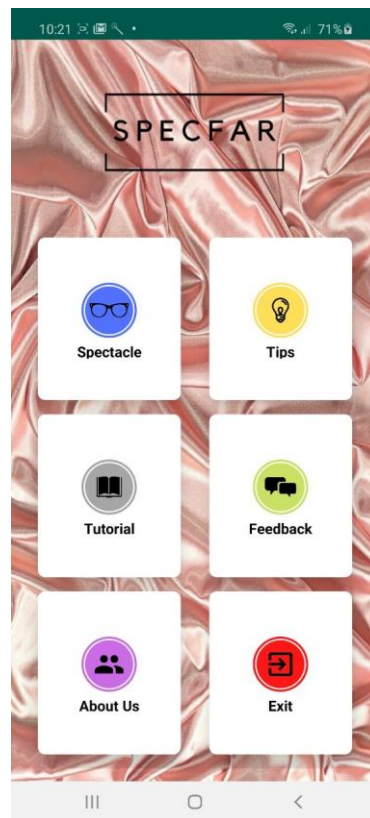
In this section, the implementation of the project is being discussed. Every feature, function and user interface design for the android mobile application will be explained in detail.



### 4.3.1 Home or main menu

The application development divided into 5 modules consist of:

1. Spectacle Frame Module
2. Tips Module
3. Tutorial Module
4. Feedback Module
5. About us Module

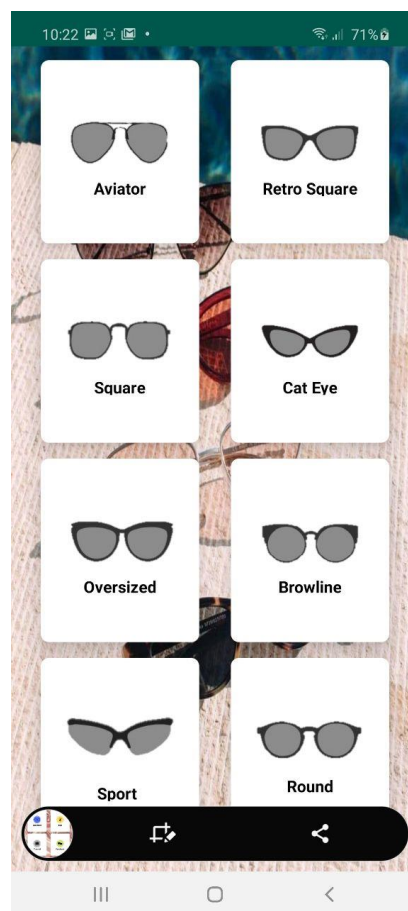


*Figure 4. 6 Main menu of SpecFAR*

Figure 4.1 displays the main menu page of SpecFAR app. The user is required to select their option to continue. Once the user selects their option, the app will go to the next page. If the user selects the exit button, the app will automatically exit.

### 4.3.2 Spectacle Frame Module

The application provides a basic type of spectacle frame for the user. There are aviator, retro square, square, cat-eye, oversized, browline, sport and round. The user would easy to illustrate the spectacle because it is consisting of an icon and name in the catalogue. The user needs to select their choice to open the camera and try augmented reality frames.



*Figure 4. 7 Spectacle frame Catalogue of SpecFAR*

The user can see themselves with the frames and decide which spectacle is the most suitable before going to the physical store. The app provides the most frequent and popular spectacles among every physical store and online store.

### 4.3.3 Tips Module

The tips module consists of two types which are eye care tips and also suggestion frame tip. Besides the user can try the frame on, they can have quick reading regarding how to find a perfect frame for their shape of the face and also tips for eyes care.



*Figure 4. 8 Eye care tips of SpecFAR App*

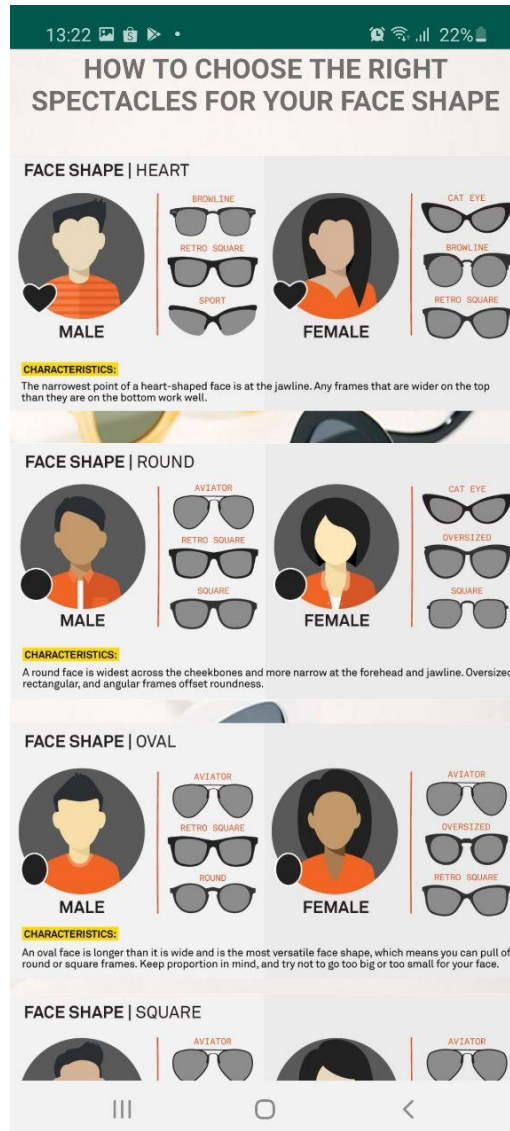


Figure 4. 9 Suggestion Tips of SpecFAR App

Figure 4.2 shows the eye care tips of SpecFAR app and figure 4.3 shows suggestion tips of SpecFAR app. SpecFAR provide an eye care tips and suggestion frame with face shape type in a visual form which is image and video. It is because people or user tend to process visual quicker than text form. The information transmitted through an image and demo video easily to remember rather than text because the information needs to memorize. So, the eye care tips provide a demo video while suggestion frame tips are in image form.

#### 4.3.4 Tutorial Module



Figure 4. 10 Tutorial on how to start the App

Figure 4.4 shows a tutorial on how to start the application. The tutorial also includes terms and condition to start the application. The user can read the tutorial if faced problems during launching the SpecFAR app. The tutorial also provides a video on how the user should interact with the AR camera. There is also a list of devices that supports the Google Play Services for AR and compatible with the mobile application. Thus, before start launching the AR camera, the user should know which devices compatible with the mobile application.

#### 4.3.5 Feedback Module

The image is a screenshot of a mobile application's feedback form. At the top, there is a dark green status bar with the time '10:22' and various icons. Below this, the word 'FEEDBACK' is centered in a large, dark font. Underneath, there are two input fields: 'Name' and 'Feedback', each with a horizontal line for text entry. A light gray button with the text 'SEND FEEDBACK' is positioned between the input fields. The background of the form is a light gray with a subtle pattern of four pairs of sunglasses. At the bottom of the screen, there is a white navigation bar with three icons: a hamburger menu, a home button, and a back arrow.

*Figure 4. 11 Feedback form of SpecFAR app*

Figure 4.5 displays the feedback form of SpecFAR application. The feedback from the user will sent directly to the developer through email or any other medium. It is purposely to gain opinion and comment from the user and improve the deficiency of the mobile application.

#### **4.4 Summary**

This chapter explained the application requirements, design, and also how to implement the application. This chapter describes the installation and configuration of the software used in the development. Android Studio has been used to develop all interface and function in SpecFAR app while supported by Google Play Service for AR that previously known as ARCore.

## **CHAPTER 5: TESTING**

### **5.1 Introduction**

This chapter describes the testing and evaluation of the project. The application is rigorously for stability in all application environments to ensure the application performed well, meets the objectives and satisfy all the requirements from the users. For this project, there will be two (2) major categories of testing involved during the development of the Spectacle Frame using Augmented Reality (SpecFAR) application which are functional and non-functional testings.

### **5.2 Functional Testing**

Functional testing ensures that the application is working as per the requirements. Most of the test conducted for this is driven by the user interface and call flows (Nimbalkar, 2013). The purpose of this testing is to give users the same output information as expected. Each function of the application is tested will be shown in the test case below.

#### **5.2.1 Test case**

A test case is where the user needs to determine whether the application under test satisfies requirements and work properly. The objective of this testing is to verify the preciseness of each module.



Table 5.1 Test case of Spectacle Frame Module

<b>Test Objective:</b> To verify the access and functionality for a catalogue of spectacle frames.					
Test ID	Test Case	Input Data	Expected Result	Actual Result	Pass/Fail
SF001	1	Click on the spectacle menu.	The user should be able to access the catalogue of the spectacle frames.	The user can access the catalogue of the spectacle frames.	Pass
<b>Test Objective:</b> To verify the functionality of the 3D frames with a compatible device.					
SF002	2	Select on a spectacle type in catalogue.	The user should see themselves with the 3D frame.	The user sees themselves with the 3D frame.	Pass
<b>Test Objective:</b> To verify the functionality of the 3D frames with an incompatible device.					
SF003	3	Select on a spectacle type in catalogue.	The user should see themselves with the 3D frame.	The camera required google services for AR latest update and support.	Pass

Table 5. 2 Test case of Tips Module

<b>Test Objective:</b> To verify the user access for eye care tips.					
<b>Test ID</b>	<b>Test Case</b>	<b>Input Data</b>	<b>Expected Result</b>	<b>Actual Result</b>	<b>Pass/ Fail</b>
EC001	4	Click on the eye care tips.	The video for eye care tips should be displayed.	The video for eye care tips displays and the user can pause the video.	Pass
<b>Test Objective:</b> To verify the user access for eye suggestion frame.					
EC002	5	Click in the suggestion frame tips.	The suggestions frame by face shape should be displayed.	The suggestions frame by face shape displays.	Pass

Table 5. 3 Test case of Tutorial Module

<b>Test Objective:</b> To verify the user access on tutorial feature.					
<b>Test ID</b>	<b>Test Case</b>	<b>Input Data</b>	<b>Expected Result</b>	<b>Actual Result</b>	<b>Pass/ Fail</b>
TT001	6	The user clicks on the tutorial button.	The tutorial on how to start the application should be display.	The tutorial on how to start the application displays on the screen.	Pass

Table 5. 4 Test case of Feedback Module

<b>Test Objective:</b> To verify the feedback feature.					
<b>Test ID</b>	<b>Test Case</b>	<b>Input Data</b>	<b>Expected Result</b>	<b>Actual Result</b>	<b>Pass/ Fail</b>
TT001	6	The user clicks on the feedback button.	The feedback form should be displayed.	The feedback form displays and can be filled.	Pass
<b>Test Objective:</b> To verify the user access on feedback form.					
TT002	7	The user enters their name and comments or feedbacks in the form.	The form should be able to be filled and submit.	The user can fill their information and submit the form.	Pass

Table 5. 5 Test case of About us Module

<b>Test Objective:</b> To verify the about us feature.					
<b>Test ID</b>	<b>Test Case</b>	<b>Input Data</b>	<b>Expected Result</b>	<b>Actual Result</b>	<b>Pass/ Fail</b>
TT001	6	The user clicks on the about us button.	The feedback form should be displayed.	The feedback form displays, and the form can	Pass

				be filled and submit.	
--	--	--	--	-----------------------	--

*Table 5. 6 Test case of Exit Module*

<b>Test Objective:</b> To verify the exit feature.					
<b>Test ID</b>	<b>Test Case</b>	<b>Input Data</b>	<b>Expected Result</b>	<b>Actual Result</b>	<b>Pass/Fail</b>
TT001	6	The user clicks on the exit button.	The application should successfully exit.	The application successfully exits.	Pass

### 5.3 Non-Functional Testing

For this project, nonfunctional testing also has been conducted. The purpose of non-functional testing is to figure out if the application will give a good experience to the user or vice versa. Non-functional testing related to the non-functional requirements. The non-functional of the application is tested and will be shown in Table 5.7 below.

*Table 5. 7 Test case of non-functional requirement*

<b>Test Objective:</b>			
<b>Test ID</b>	<b>Test Case</b>	<b>Expected Result</b>	<b>Actual Result</b>
Performance	The application must be able to	The application should be able	The responding time is vary

	respond within 10-20 seconds for each button.	respond within 10-20 seconds.	depending on the device processor itself.
Maintainability	The application is practical, does not costly and time consuming.	The application can be every day used and does not consume money and time.	This application can be used every day, does not costly to be functioning and time taken to use the application is reasonable.
Portability	The application can be carried around by using mobile devices.	The user should be able to carry this application around.	The application will be installed in mobile devices that can be carried easily.

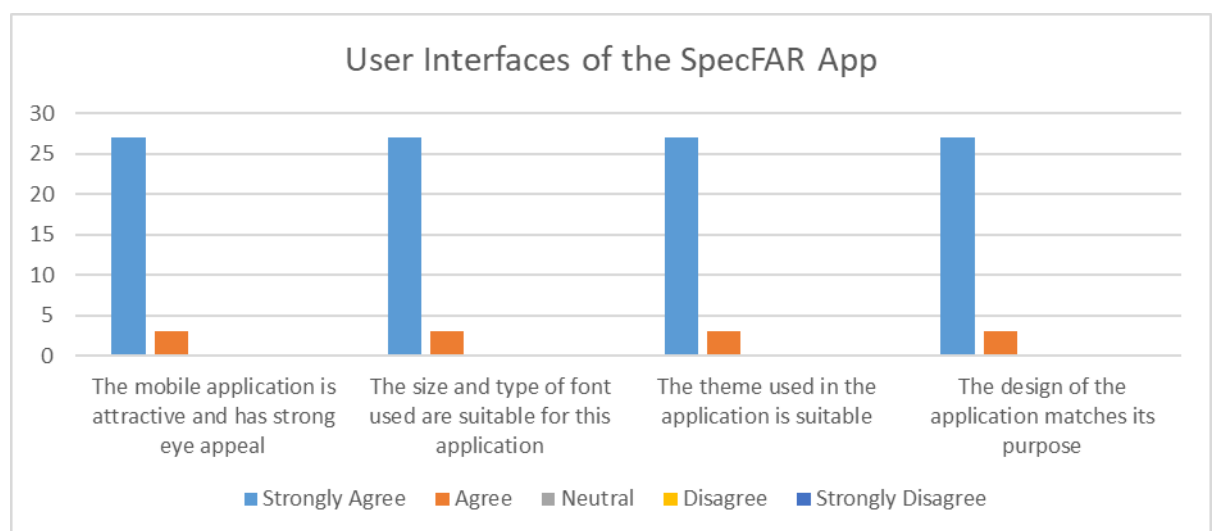
### 5.3.1 Usability Testing

The usability testing is conducted to evaluate the SpecFAR app while the real user using it. The questionnaire is handed out to the user to get the feedback from them. The sample questionnaire for usability testing has been attached in the Appendix G for reference. SpecFAR is tested by 30 people which consists of users and optometrists or eyewear shop workers. The questionnaire divided into three sections which are section A, section B and

section C. Section A consist of demographic of the respondent, section B consist of the application user interfaces and section C consist of application user experience, respectively.

### 5.3.1.1 User Interfaces

Under the User Interfaces category, the respondents were asked to evaluate the design of the application in terms of attractiveness and the suitability in the application. Figure 5.1 represents the results for the user interfaces testing.

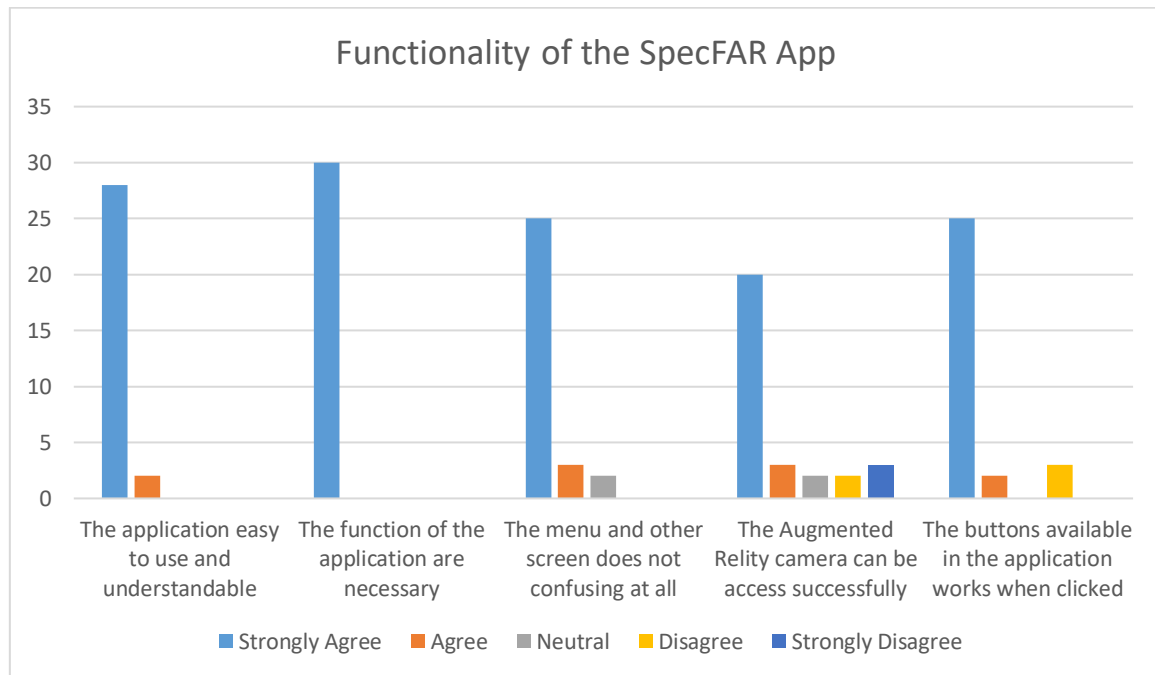


*Figure 5. 1 Result for the user interfaces of SpecFAR App*

Based on Figure 5.1, most of the respondent agrees with the interfaces that SpecFAR App provide. Furthermore, 27 out of 30 respondents strongly agreed that the mobile application is attractive and has strong eye appeal to them while the other 3 respondents still agree with that statement. Regarding the size and type of font used, all the respondents are agreed and strongly agreed with them. 27 of respondents strongly agreed with the theme used in the application is suitable and does not confuse at all. Next, 27 of respondents strongly agreed with the design of the application is matches the purpose of the project. Meanwhile, 3 of the respondents agree with the statement.

Based on the result of the questionnaire, most of the users which consist of the user and also eyewear shop staff has agreed with the current interfaces of the SpecFAR App.

### 5.3.1.2 User Functionality



*Figure 5. 2 Result for the functionality of SpecFAR App*

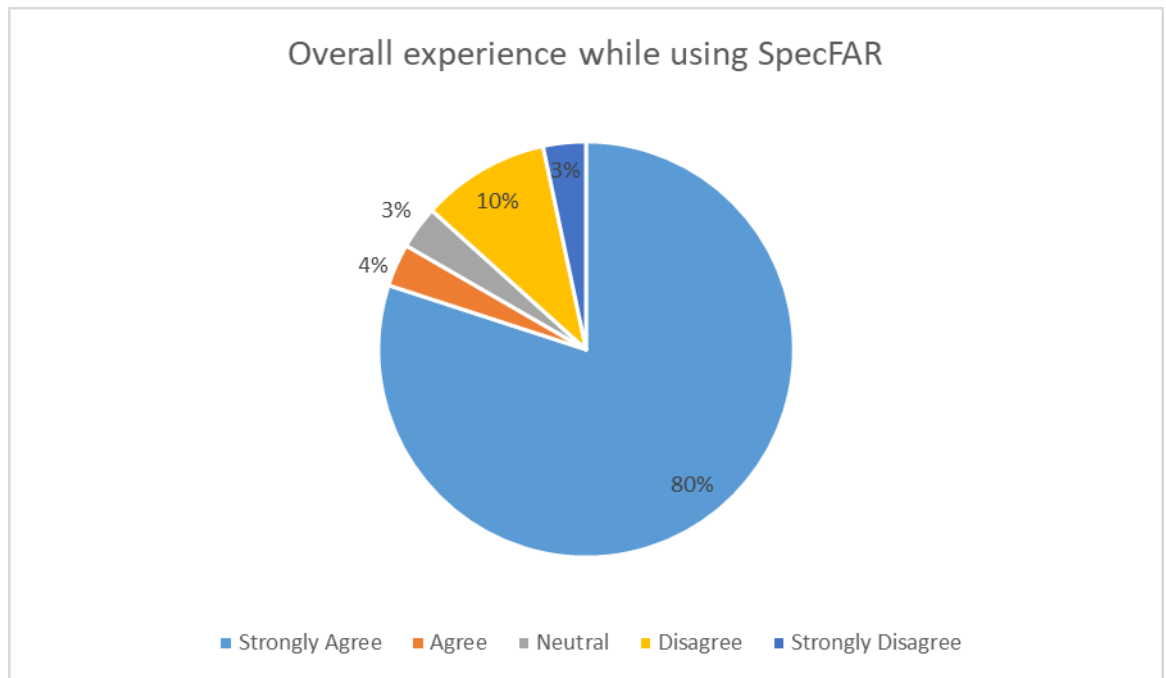
Figure 5.2 shows the result for the functionality of SpecFAR App that has been tested by 30 of respondents. The graph illustrates positive feedback from the users which most of the answer is strongly agreed and agreed. 28 of the respondents strongly agreed that the application is easy to use and understandable. The other 2 respondents also agreed that the application is easy and understandable to use. Next, all the respondents strongly agreed that the function in the application is necessary. We can conclude that the users need those functions and features in the SpecFAR App. 20 out of 30 respondents strongly agreed that the menu page and the other page does not confuse their usage and experience during testing the application. Meanwhile 2 of the respondents neutral regarding the statement. Besides that, there are a lower percentage of the respondent agree with the statement that said the

augmented reality camera can be accessed successfully. This problem due to the limitation and constraint of the application. The AR camera can be accessed successfully if only the device is compatible and comply with the conditions of the application. There are 5 of the respondents could not access the camera and the application required the latest installation of the Google services for ArCore in the google play store. Meanwhile, 2 of the respondents have access to the camera but did not support the 3D model as the 3D model cannot appear on their face. 20 of the respondents can access the AR camera and successfully access the AR spectacle frames. Lastly, 25 out of 30 respondents strongly agreed that the buttons available in the application works when clicked. Meanwhile, 2 of the respondents agree and the other 3 respondents disagree the button did not work out. This problem due to the AR camera button that cannot directly open and required the google services for AR in the google play store.



### 5.3.1.3 Overall Evaluation of the Application

Figure 5.3 illustrates the result of the evaluation for the overall experience during testing of mobile-based application of Spectacle Frame using Augmented Reality.



*Figure 5. 3 The result for overall experience using SpecFAR App*

Based on Figure 5.3, 80% of the users were very satisfied and strongly agreed with the application and 3% were satisfied and agreed with the overall application. The satisfied respondents with the overall application can perform well and manage to access all the features in the application. However, there are 3% of respondents were not satisfied and strongly disagree and 10% of the respondent disagreed with the overall of the application. The respondents that were not satisfied with the application were not able to access the main feature which is the AR camera. There are also 3% of the respondents respond to the application is neutral which means either satisfied or unsatisfied with the application. The remaining respondents answered neutral option due to the compatible access on their iOS

device but they manage to experience the application through another device which compatible and can perform well in the application. As a conclusion, there is a huge percentage of the user satisfied and agree with the whole application of SpecFAR App.

#### **5.4 Summary**

This chapter discussed the testing method used for the SpecFAR App. Any errors or design flaws are detected and fixed during this stage. Two categories of testing have been done in this project which are functional and non-functional testings. Functional testing focused on features and functions in the application while non-functional testing is focused on the readiness of the application.

## CHAPTER 6: CONCLUSION AND FUTURE WORK

### 6.1 Introduction

Chapter 6 discusses and reviews the achievements of the completed application, the limitations and the future works that should be improved in the future to make the SpecFAR App more efficient.

### 6.2 Project Achievement

A mobile-based application of Spectacle Frames using Augmented Reality has been successfully developed to encounter the problems that have been discussed in Chapter 1. All the objectives of the project also have been achieved. Table 6.1 shows the objectives of the project and the accomplishment of the project.

*Table 6. 1 Objectives and achievements*

Objectives	Achievements
To design an interactive mobile application to attract customer to trying and choosing spectacle frames.	The Spectacle Frames using Augmented Reality (SpecFAR) application has been designed and successfully attract the user.
To develop an efficient application for eyewear shop to serve their customer.	The mobile-based application of Spectacle Frame using Augmented Reality (SpecFAR) has successfully developed. The main function which allows the user to fitting the spectacle frames has developed. The extra

	functions also has been developed such as suggestion frames tips, eye care tips, tutorial on how to start the app, feedback for the user comments about the app and about us section to easier the user find the information about the developer and supervisor of the app.
To evaluate the usability of the mobile application among users.	The usability testing has been conducted and the feedback has been discussed. The testing has distributed to 30 respondents. There are a huge percentage and significant in results that the user strongly agreed with the User Interfaces category. Therefore, 80% of the respondents were satisfied and strongly agreed with the overall application.

### 6.3 Limitations and Constraints

The limitation of the application refers to the restriction of the application to the users and it is one of the huge challenges of the mobile application. There are several limitations exist in the project. The limitation and constraints of the application in this project are: -

- i. The application is developed specifically for Android platform. Users that do not have any android device cannot install and experience the mobile application.

- ii. The Augmented Reality camera required Android version 9.0 and above. The device with the Android below than 9.0 version can access the other features except for the AR camera, where the user needs to get the latest update of google services for AR in google play. The list of devices that support AR camera is included in the tutorial section in the application.

## **6.4 Future Works**

The purpose of the future works is to improve the current application even though all the objectives of the project have been achieved. Several aspects can be considered to enhance the application for this project are suggested as below: -

- i. The priority of all user needs to be fulfilled in order to build a good mobile app. The application should be available in all type of platform and devices such as iOS device and Android device.
- ii. The 3D frames provided in the catalogue are limited. Thus, in the future, need to add more type and design with a variety of colour. The selection of colour also contributes to the choice of the users.
- iii. The minimum requirement of the Android version to get the google services for AR need to be minimized as much as can. It helps all the users to have all access features in the mobile application.

## **6.5 Conclusion**

The SpecFAR mobile application is introduced by utilising Augmented Reality (AR) with face camera in mobile devices. Throughout this project, knowledge and skills have been acquired as researching and studied regarding the mobile application. The objectives of the mobile-based application of Spectacle Frame using Augmented Reality does achieve completely and the application working perfectly. Somehow, the application still has several

limitations and constraint. The application can be enhanced in the future to fulfil all the user needs or requirements and become a great application for all users.

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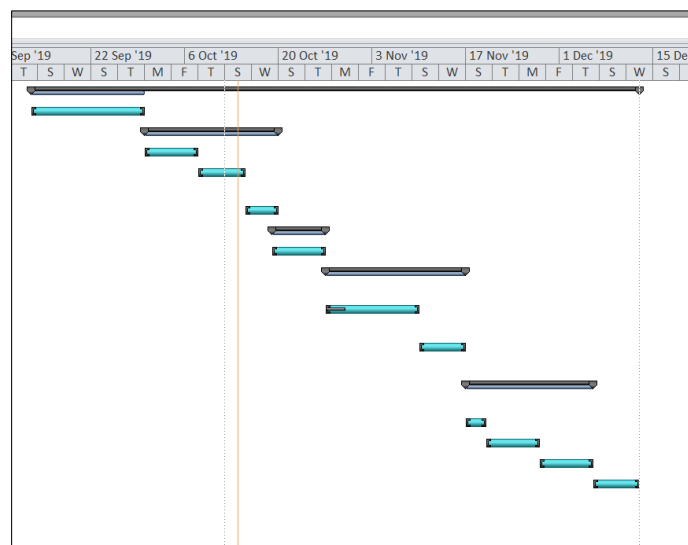
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## APPENDIX A: PROJECT SCHEDULE

Start						
15 Sep '19 22 Sep '19 29 Sep '19 6 Oct '19 Today						
	Task Mode	Task Name	Duration	Start	Finish	P
1	✚	Final Year Project 1	65 days	Fri 13/9/19	Thu 12/12/19	
2	✚	Brief Proposal	12 days	Fri 13/9/19	Sun 29/9/19	
3	✚	Project Proposal	16 days	Mon 30/9/19	Sat 19/10/19	
4	✚	Research on project	6 days	Mon 30/9/19	Mon 7/10/19	
5	✚	Identifying objectives and project scope	5 days	Tue 8/10/19	Mon 14/10/19	
6	✚	Determine methodology	5 days	Tue 15/10/19	Sat 19/10/19	
7	✚	Chapter 1: Introduction	7 days	Sat 19/10/19	Sat 26/10/19	
8	✚	Finalize project proposal	7 days	Sat 19/10/19	Sat 26/10/19	
9	✚	Chapter 2: Literature Review	17 days	Sun 27/10/19	Sat 16/11/19	
10	✚	Gathering journals and information on existing	12 days	Sun 27/10/19	Sat 9/11/19	
11	✚	Analyze informations and documentation	7 days	Sun 10/11/19	Sat 16/11/19	
12	✚	Chapter 3: Requirement Analysis and Design	15 days	Sun 17/11/19	Thu 5/12/19	
13	✚	Collect all requirements	3 days	Sun 17/11/19	Tue 19/11/19	
14	✚	Create ERD and DFD	6 days	Wed 20/11/19	Wed 27/11/19	
15	✚	Basic design of system	6 days	Thu 28/11/19	Thu 5/12/19	
16	✚	Final Year Project 1	5 days	Fri 6/12/19	Thu 12/12/19	

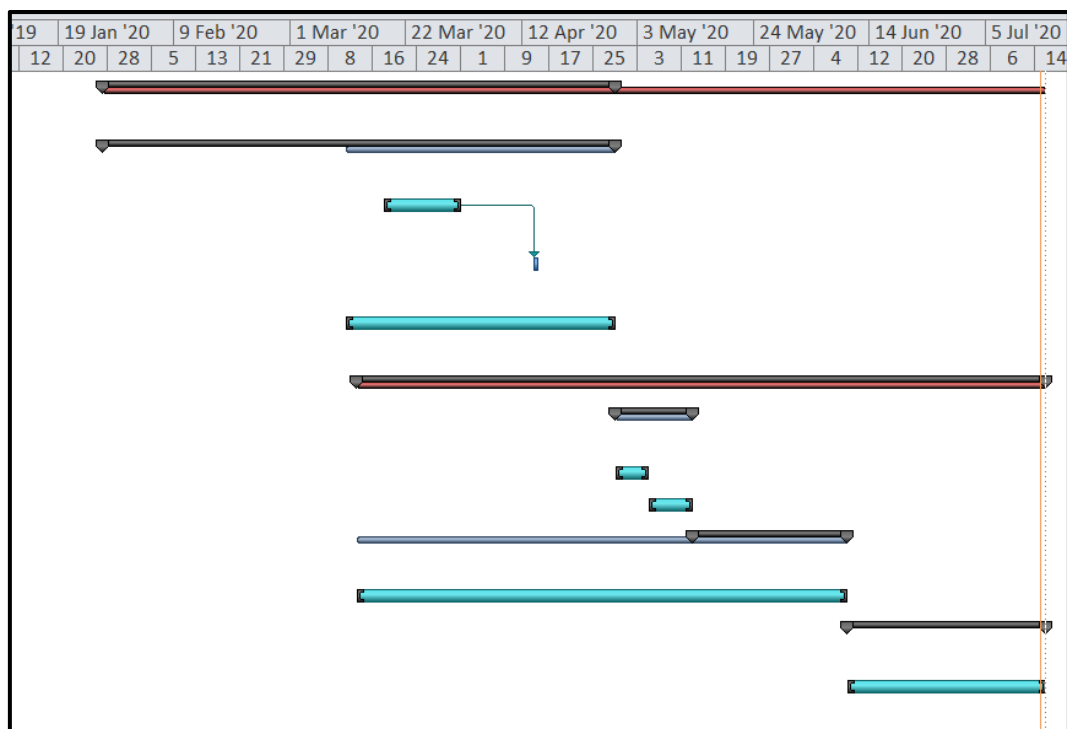
*Project Schedule Description for FYP 1, Semester 2019/2020*



*Gantt Chart for FYP 1, Semester 2019/2020*

	Task Mode	Task Name	Duration	Start	Finish
		Chapter 4: Implementation	67 days	Mon 27/1/20	Tue 28/4/20
		Coding and Implementation	67 days	Mon 27/1/20	Tue 28/4/20
		Movement Control Order Phase 1	10 days	Wed 18/3/20	Tue 31/3/20
		Movement Control Order Phase 2	1 day	Tue 14/4/20	Tue 14/4/20
		Movement Control Order Phase 3	35 days	Wed 11/3/20	Tue 28/4/20
		Chapter 5: Testing	89 days	Fri 13/3/20	Wed 15/7/20
		Movement Control Order Phase 4	10 days	Wed 29/4/20	Tue 12/5/20
		Test application	4 days	Wed 29/4/20	Mon 4/5/20
		Prepare test result	6 days	Tue 5/5/20	Tue 12/5/20
		Movement Control Order Phase 5	20 days	Wed 13/5/20	Tue 9/6/20
		Fix bugs and errors	63 days	Fri 13/3/20	Tue 9/6/20
		Movement Control Order Phase 6	26 days	Wed 10/6/20	Wed 15/7/20
		Prepare FYP Report	26 days	Wed 10/6/20	Wed 15/7/20

*Project Schedule Description for FYP 2, Semester 2019/2020*



*Gantt Chart for FYP 2, Semester 2019/2020*

## APPENDIX B: DATA COLLECTION OFFICIAL LETTER

Fakulti Sains Komputer dan Teknologi Maklumat  
Faculty of Computer Science and Information Technology

UNIMAS/NC-19.03/04-32 ( 34 )

28 Oktober 2019

KEPADA SESIAPA YANG BERKENAAN

Tuan/Puan,

**Pemohonan Mengumpul Maklumat Untuk Projek Tahun Akhir**  
- Nurul Nusratina binti Ibrahim

Dengan segala hormatnya perkara di atas adalah dirujuk.

Sukacita dimaklumkan bahawa pelajar berikut akan mengumpul maklumat untuk projek beliau. Berikut adalah butir-butir pelajar:

Nama Penuh	: Nurul Nusratina binti Ibrahim
No. Matrik	: 57556
No. Kad Pengenalan	: 970129136660
Program	: Pengkomputeran Multimedia
Tahun Pengajian	: 4
Tajuk Projek	: <i>SpecFAR: Spectacle Frames using Augmented Reality</i>
Penyelia	: Dr Suriati Khartini binti Jali Tel: 082-582647

Sehubungan itu, sukacita kiranya pihak tuan/puan dapat memberikan kerjasama kepada pelajar berkenaan untuk menyalurkan maklumat yang diperlukan bagi memenuhi syarat kursus. Segala maklumat yang diperolehi akan hanya digunakan untuk tujuan akademik semata-mata dan akan dijamin kerahsiaannya.

Ini adalah sebagai makluman kepada pihak tuan/puan dan sekiranya ada sebarang pertanyaan, sila hubungi penyelia pelajar tersebut.


Sekian, terima kasih.

  
Annabel anak Katek  
Penolong Pendaftar Kanan

s.k. - Timbalan Dekan (Prasiswazah), FSKTM  
- Dr Suriati Khartini binti Jali, FSKTM

MSC-Status

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## APPENDIX C: CONSENT LETTER FOR DATA COLLECTION

### *An Investigation into User Interaction and Experience Focusing on Spectacle Frames using Augmented Reality*

#### *Introduction*

Welcome

Dear All,

You had been invited to take part in a survey entitled 'An Investigation into User Interaction and Experience Focusing on Spectacle Frames using Augmented Reality'.

This study is being carried out by Nurul Nusratina binti Ibrahim, currently a student at Faculty of Computer Science and Information Technology, Universiti Malaysia Sarawak (UNIMAS). The research aims to explore the needs and expectations of the current issues and potential in eyewear shops and customers. This research will therefore investigate user reaction and experiences regarding the fitting frames using Augmented Reality.

The result of this research will be written up and presented as part of the Final Year Project report.

If you have any questions or concern, please contact us using either the e-mail or telephone details below.

Nurul Nusratina Binti Ibrahim

Email: [57556@siswa.unimas.my](mailto:57556@siswa.unimas.my)

## APPENDIX D: GATHERING REQUIREMENTS QUESTIONNAIRE

### QUESTIONNAIRE FOR USER

#### SECTION A

##### SECTION A: PERSONAL DETAILS

1. Gender: ☐ Male ☐ Female
2. Age:  
☐ below than 18 years old  
☐ 18 - 35 years old  
☐ 36 - 55 years old  
☐ older than 55 years old
3. Do you have any sight problem?  
☐ Yes ☐ No
4. Do you wear spectacle in daily life?  
☐ Yes ☐ No
5. Have you ever come to any eye wear store or seek optometrist?  
☐ Yes ☐ No

#### SECTION B

##### SECTION B: USER REACTION

1. Which do you prefer to buy eye wear?  
☐ Online Store  
☐ Physical Store
2. How long did you take for fitting eye wear?  
☐ Within 5 minutes  
☐ Within 30 minutes  
☐ 30 minutes and above
3. Have you heard about Augmented Reality?  
☐ Yes ☐ No
4. Have you experienced Augmented Reality in mobile applications? (such as Snapchat and Instagram filters)  
☐ Yes ☐ No



Figure 1 Spectacle Frame Fitting using AR

Figure 1 shows example of fitting spectacle frames with the AR technology. The proposed mobile app provides the feature that user can see themselves wearing spectacle frame which is in Augmented Reality (AR) technology. User can switch to another spectacle frames just in a click or swipe the catalogue. It also provides some tips such as eye care and suggestion frames for user.

5. The following questions are regarding the proposed mobile-based application of Spectacle Frames using Augmented Reality. Please tick (✓) your preference using the following scales:

Btl.	Statement	Strongly agree	Agree	Moderate	Disagree	Strongly disagree
1	What do you think if any eyewear shop provides a fitting frame with AR technology?					
2	The proposed mobile app will help optometrist to improve the assisting customer process.					
3	The proposed mobile app convenient to use as it does not require user to go store.					
4	The proposed mobile app will take a shorter time to perform the fitting frames.					
5	The eye care tips in the proposed mobile app is a good idea for user.					
6	The suggestion frames by face shape in the proposed mobile app is helpful for user to choose their frame.					

6. Is there any other suggestion(s) and comment(s) that you would like to add to improve the proposed mobile app?

---

## QUESTIONNAIRE FOR OPTOMETRIST AND EYEWEAR SHOP

1. Gender: <input type="checkbox"/> Male <input type="checkbox"/> Female	
2. Age:	
<input type="checkbox"/> below than 18 years old	
<input type="checkbox"/> 18 - 35 years old	
<input type="checkbox"/> 36 - 55 years old	
<input type="checkbox"/> older than 55 years old	
3. How often your customer come to store in a day?	
<input type="checkbox"/> Never come	
<input type="checkbox"/> Rarely	
<input type="checkbox"/> Sometimes	
<input type="checkbox"/> Often	
<input type="checkbox"/> Always	
4. How long the time taken for you assist your customer?	
<input type="checkbox"/> Within 5 minutes	
<input type="checkbox"/> Within 30 minutes	
<input type="checkbox"/> 30 minutes and above	
5. Have you faced such following problems during assisting your customer? If yes, tick your answer in the box.	
<input type="checkbox"/> Customer accidentally cause damage on spectacle frame	
<input type="checkbox"/> Customer take a long time to choose their frame	
<input type="checkbox"/> Customer hard to choose their frame based on face shape suitability	
<input type="checkbox"/> Customer want to try out spectacle frame that are not in stock	
If there are any other problems, please state below	
<hr/>	
6. Have you heard about Augmented Reality (AR)?	
<input type="checkbox"/> Yes <input type="checkbox"/> No	
7. Have you experienced Augmented Reality in mobile applications? (such as Snapchat and Instagram filters)	
<input type="checkbox"/> Yes <input type="checkbox"/> No	



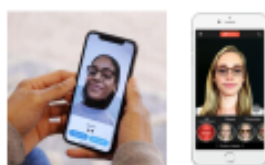


Figure 1 Spectacle Frame Fitting using AR

Figure 1 shows example of fitting spectacle frames with the AR technology. The proposed mobile app provides the feature that user can see themselves wearing spectacle frame which is in Augmented Reality (AR) technology. User can switch to another spectacle frames just in a click or swipe the catalogue. It also provides some tips such as eye care and suggestion frames for user.

8. The following questions are regarding the proposed mobile-based application of Spectacle Frames using Augmented Reality. Please tick (✓) your preference using the following scales:

Bil.	Statement	Strongly agree	Agree	Moderate	Disagree	Strongly disagree
1	What do you think if any eyewear shop provides a fitting frame with AR technology?					
2	The proposed mobile app will help optometrist to improve the assisting customer process.					
3	The proposed mobile app convenient to use as it does not require user to go store.					
4	The proposed mobile app will take a shorter time to perform the fitting frames.					
5	The eye care tips in the proposed mobile app is a good idea for user.					
6	The suggestion frames by face shape in the proposed mobile app is helpful for user to choose their frame.					

9. Is there any other suggestion(s) and comment(s) that you would like to add to improve the proposed mobile app?

---

## APPENDIX E: USABILITY TESTING OFFICIAL LETTER

Fakulti Sains Komputer dan Teknologi Maklumat  
Faculty of Computer Science and Information Technology



www.unimas.my

UNIMAS/NC-19.03/04-32 ( 55 )

17 Jun 2020

### KEPADA SESIAPA YANG BERKENAAN

Tuan/puan,

**Permohonan Mengumpul Maklumat Untuk Projek Tahun Akhir  
- Nurul Nusratina binti Ibrahim**

Dengan segala hormatnya perkara di atas adalah dirujuk.

Sukacita dimaklumkan bahawa pelajar berikut akan mengumpul maklumat untuk projek beliau. Berikut adalah butir-butir pelajar:

Nama Penuh	:	Nurul Nusratina binti Ibrahim
No. Matrik	:	57556
No. Kad	:	970129136660
Pengenalan	:	
Program	:	Pengkomputeran Multimedia
Tahun Pengajian	:	4
Tajuk Projek	:	SpecFAR: Spectacle Frames using Augmented Reality
Penyelia	:	Dr. Suriati Khartini Binti Jali Tel: 082 - 582647

Sehubungan itu, sukacita kiranya pihak tuan/puan dapat memberikan kerjasama kepada pelajar berkenaan untuk menyalurkan maklumat yang diperlukan bagi memenuhi syarat kursus. Segala maklumat yang diperolehi akan hanya digunakan untuk tujuan akademik semata-mata dan akan dijamin kerahsiaannya.

Ini adalah sebagai makluman kepada pihak tuan/puan dan sekiranya ada sebarang pertanyaan, sila hubungi penyelia pelajar tersebut.

Sekian, terima kasih.

  
Annabel anak Katek  
Penolong Pendaftar Kanan

s.k. - Timbalan Dekan (Prasiswazah), FSKTM  
- Penyelia, FSKTM



94300 Kota Samarahan, Sarawak, MALAYSIA | Tel + 60 82 581 000 | Fax + 60 82 583 764

## **APPENDIX F: CONSENT LETTER FOR USABILITY TESTING**



UNIVERSITI MALAYSIA SARAWAK

FACULTY OF COMPUTER SCIENCE AND INFORMATION TECHNOLOGY

QUESTIONNAIRE FOR FINAL YEAR PROJECT

### **MOBILE-BASED APPLICATION OF SPECTACLE FRAME USING AUGMENTED REALITY (SPECFAR)**

*My name is Nurul Nusratina Ibrahim, a bachelor degree in Computer Science and Information Technology at University Malaysia Sarawak (UNIMAS). I would like to invite you to participate in my final year project, development of Mobile-Based Application of Spectacle Frame using Augmented Reality (SpecFAR).*

*The objective of Mobile-Based Application of Spectacle Frame using Augmented Reality (SpecFAR) is to design and develop a mobile-based application to improvise the current method in eyewear shop. All user or customer can try spectacle frame virtually using the*

*Augmented Reality in the mobile-based application. Other than that, the user can access informative eye care tips and suggestion frame for their face shape.*

*This survey contains 4 sections takes approximately less than 20 minutes of your time., although it could take slightly longer depending on your answers. If you are interested and willing to participate, please proceed to the survey.*

*My final year project is supervised by Dr Suriati Khartini Jali and she can be contacted at [jskhartini@unimas.my](mailto:jskhartini@unimas.my).*

*If you have any questions about the survey, please feel free to contact me directly at [nurulnusratina22@gmail.com](mailto:nurulnusratina22@gmail.com).*

*Thank you very much for taking in this survey. Your contribution is very valuable and I highly appreciate the time you have volunteered.*

*Best regards,*

*Nurul Nusratina Ibrahim*

*Bachelor Degree in Computer Science and Information Technology*

*Univerisiti Malaysia Sarawak*

## **APPENDIX G: USABILITY TESTING QUESTIONNAIRE**

### **SECTION A: DEMOGRAPHICS OF THE RESPONDENT**

1. What is your gender?

☐ Male

☐ Female

2. How old are you?

☐ below than 18 years old

☐ 18-35 years old

☐ 36-55 years old

☐ older than 55 years old

3. Do you have any sight problem?

☐ Yes

☐ No

4. Do you wear a spectacle in daily life?

☐ Yes

☐ No

5. Have you ever come to any eyewear store or seek optometrist?

☐ Yes

☐ No

## SECTION B: APPLICATION USER INTERFACES

Please tick to rate the level and agreement of the mobile application.

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

No.	Statement	1	2	3	4	5
1	The mobile application is attractive and has strong eye appeal.					
2	The size and type of font used are suitable for this application.					
3	The theme used in the application is suitable.					
4	The design of the application matches its purpose.					

Is there any other comment(s) to improve the interfaces of SpecFAR App?

---

## SECTION C: APPLICATION USER EXPERIENCE

Please tick to rate the level and agreement of the mobile application.

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

No.	Statement	1	2	3	4	5
-----	-----------	---	---	---	---	---

1	The application easy to use and understandable.					
2	The function of the application is necessary.					
3	The menu and other screen do not confuse at all.					
4	The Augmented Reality camera can be access successfully.					
5	The buttons available in the application works when clicked.					

Is there any other comment(s) to improve the functionality of SpecFAR App?

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#### **SECTION D: OVERALL EXPERIENCE**

How would you rate the overall experience while using the SpecFAR App?

- ☐ Very Unsatisfied
- ☐ Unsatisfied
- ☐ Neutral
- ☐ Satisfied
- ☐ Very Satisfied